BIOLOGICAL INVESTIGATIONS OF THE ST. LUCIE ESTUARY (FLORIDA) IN CONNECTION WITH LAKE OKEECHOBEE DISCHARGES THROUGH THE ST. LUCIE CANAL

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A. INTRODUCTION

A survey of the turbidity, salinity and sediment effects of St. Lucie Canal discharge into the St. Lucie Estuary was authorized by the Chief of Engineers on May 9, 1955. Expansion of that program to include the work of the present biological investigation was authorized by the Chief of Engineers on June 12, 1956.

The scope and purpose of this biological work was to: (a) review the history of the St. Lucie Canal and analyze the problems concerned with discharges of fresh water into the St. Lucie Estuary; (b) present biological data from a 2-year investigation of estuarine conditions, January 1957 to January 1959; (c) determine the biological effects of operation of St. Lucie Lock and Dam with reference to important indicator species and evaluate the wide range of claimed damages relative thereto; and (d) determine operational procedures, practicable within the specific operational requirements of the project, which would either be beneficial or of the least damage to estuarine fishes and fishing conditions.

A report (Gunter, 1959) covering all sections of the work, but with particular reference to (c) and (d) was submitted to the Jacksonville District of the Corps of Engineers. The present paper covers enough of (a) to give a background for exposition of the biological work and gives an expanded presentation of the biological data.

Mr. Chester Adams, boat operator, Clewiston Area Office, and Messrs. Robert Highsmith and Paul Berry, Survey Branch, Jacksonville District, ably assisted in the field collections.

B. BASIC CONSIDERATIONS

1. *Purpose and history of St. Lucie Canal* — St. Lucie Canal was built originally by the Everglades Drainage District to provide an improved outlet to tidewater for control of floodwaters in Lake Okeechobee. Construction along the shortest and cheapest route to tidewater was begun in 1916 and practically completed in 1924. At that time the canal, with a capacity of 5,000 cubic feet a second with Lake Okeechobee at elevation 15.6 feet, was controlled by two dams, one near the lake and the other near the lower end. (All stages and elevations throughout this report refer to mean sea level datum). Serious shoaling of eroded material and reduction of channel capacity occurred as a result of storms in 1924, 1926, and 1928. The deposited material was excavated by the Drainage District in 1927 and 1928 but channel capacity was again reduced during the storm of 1930. In 1930 the United States Government accepted control of Lake Okeechobee as an authorized project, and since that date the canal has been maintained and operated by the Corps of Engineers. Construction of fixed spillways at 16 inflow points along the banks of St. Lucie Canal was initiated in 1933 in order to prevent sediment from entering the canal. In 1937, the waterway was improved to provide a navigable channel 6 feet deep. The River and Harbor Act of 1937 authorized replacement of obsolete structures at the two locks with a new lock and spillway at the site of the lower dam. The main spillway was completed in 1944, except for tainter gates which were installed in 1950. The canal was enlarged in 1949 to provide a navigable depth of 8 feet and a discharge capacity of about 9,000 cubic feet a second with the lake stage at 15.6 feet.

2. *Location and description.* — a. *St. Lucie Canal* leaves Lake Okeechobee at Port Mayaca and extends northeast about 25.6 miles to the South Fork of St. Lucie River, 7 miles south of the confluence of the North and South Forks of that river at Stuart. St. Lucie Lock and Dam are located about 1.9 miles from the lower end of the canal, or about 23.7 miles from the entrance of Lake Okeechobee. The local watershed of the canal between the lake and the lock and dam, 79 percent of which is on the north side, covers 185 square miles. The area is imperfectly drained, with flat slopes, many swamps, and small lakes, and is often wet. Elevations range from 45 feet along the northerly divide to 20 to 25 feet along the canal. The soil is mostly fine sands and the native vegetation principally wild grasses, sawgrass, and scattered pine and palmetto growth. St. Lucie Canal is a part of the cross-State Okeechobee Waterway that extends from the Atlantic Ocean near Stuart to the Gulf of Mexico southwest of Fort Myers. It is one of two primary outlets used in regulating Lake Okeechobee levels under the Central and Southern Florida Flood Control Project.

b. *St. Lucie Estuary.* — (1) *General location.* — St. Lucie Estuary is located in the tidewater area at the junction of the North and South Forks of St. Lucie River near Stuart, in Martin County, Fla. (plate 1). The main river empties into the Atlantic Ocean through St. Lucie Inlet, about 8 miles from where the two forks join. The outer portion of the estuary is separated from the Atlantic Ocean by two long strips of land between which flows the Indian River. The latter, except for the 8-foot dredged Intracoastal Waterway, is a shallow lagoon that also discharges into St. Lucie Inlet.

(2) *St. Lucie Inlet* was opened by citizens in the vicinity in 1892. It was originally 30 feet wide and 5 feet deep, but by 1898 it had widened to 1,700 feet with available depths at low water of 6 to 7 feet. Prior to opening of the inlet, St. Lucie River flowed into Indian River. Tidal currents in the estuary were low, and the water in lower St. Lucie River probably was much fresher than it is now.

(3) *Description and physical characteristics.* — St. Lucie Estuary consists of three main sections. Pertinent reference points and depth information are shown on plate 2. The outer and largest portion of the estuary extends from Sewall Point near the mouth of Indian River to Roosevelt Bridge (US 1) at Stuart. Two points of land there constrict the river opening to separate the outer from the inner estuary. The North Fork and South Fork arms comprise the inner estuary. The North Fork Estuary extends from the junction at Stuart to the mouth of the North Fork River near Kitching Cove. It receives runoff from a drainage area of 450 square miles in St. Lucie and Martin Counties via the North Fork of St. Lucie River, numerous agricultural drainage canals, and Bessey Creek. The South Fork of the estuary extends from United States Highway 1 bridge to the mouth of St. Lucie River above the Palm City bridge. The total surface area, volume of water, and miles of shoreline at mean low water in each of three sections of the estuary are given in table 1.

During non-discharge years and low flow periods, tidal waters extend up the South Fork to St. Lucie Lock and several miles up North Fork River. The mean range of tide is 2.6 feet at St. Lucie Inlet and 1.3 feet at Stuart. Normal salinities range from 5.0 to 20.0 parts per thous-

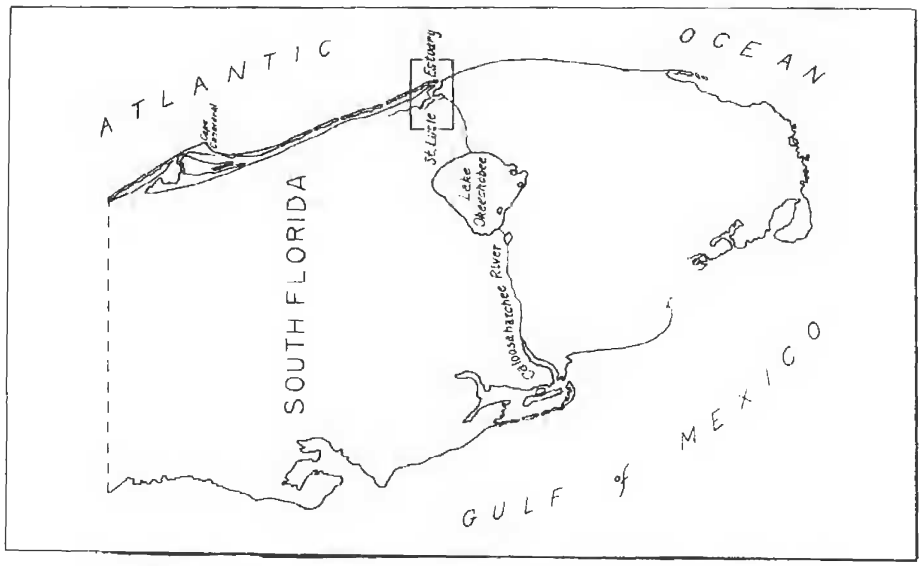


Plate 1 — General location of the St. Lucie Estuary.

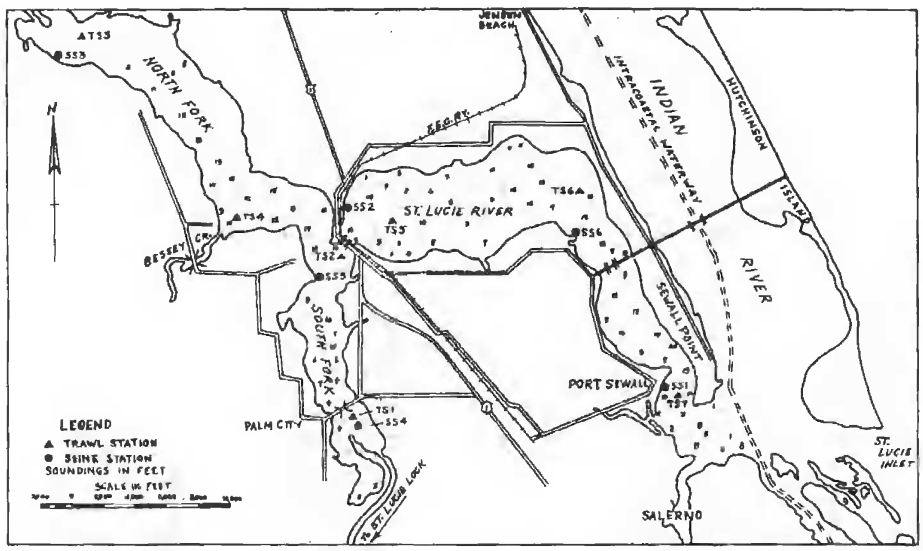


Plate 2 — A map of the St. Lucie Estuary showing trawl and seine stations and depths in feet.

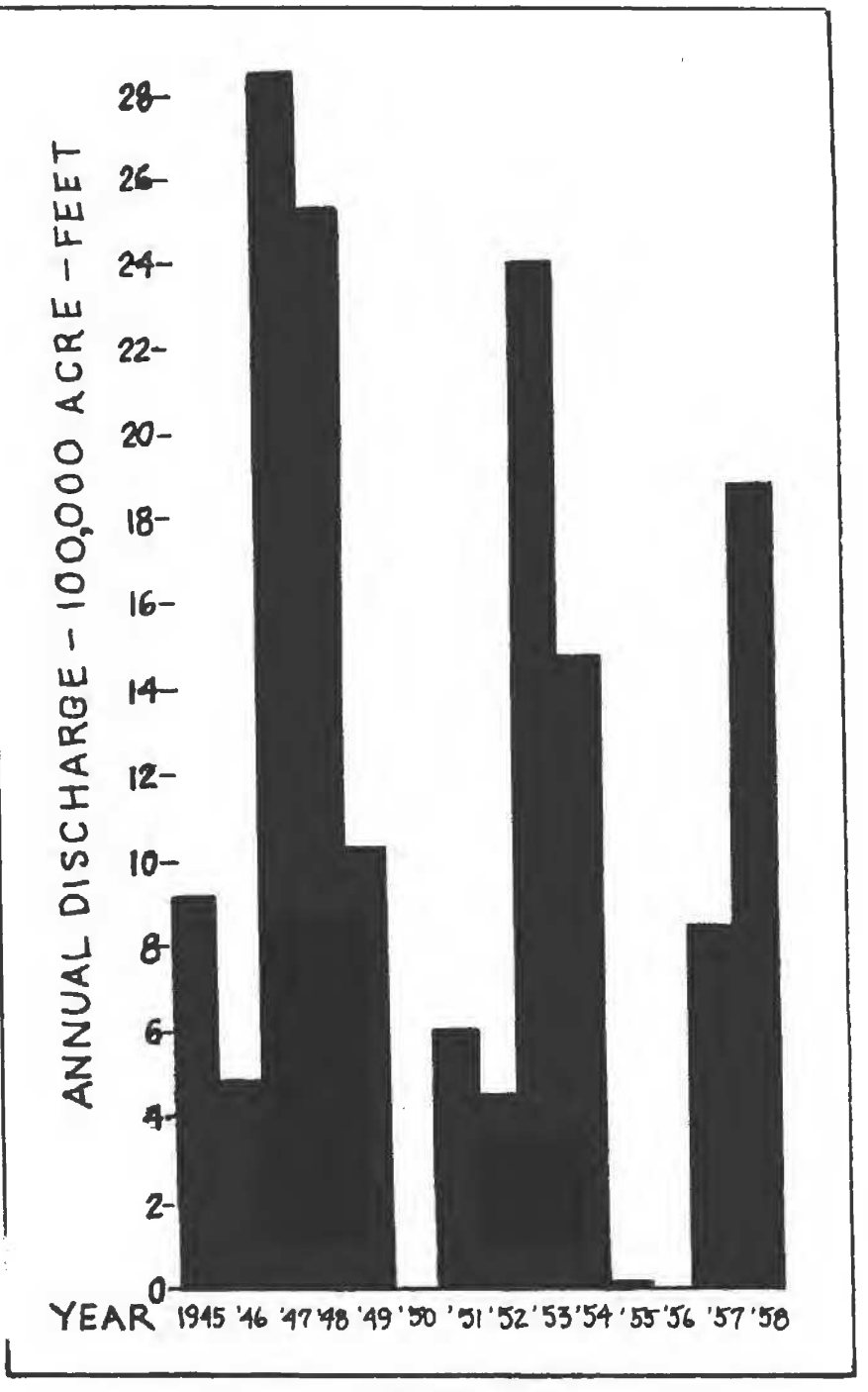


Plate 3 — Discharge through the St. Lucie Lock and Dam for the years shown.

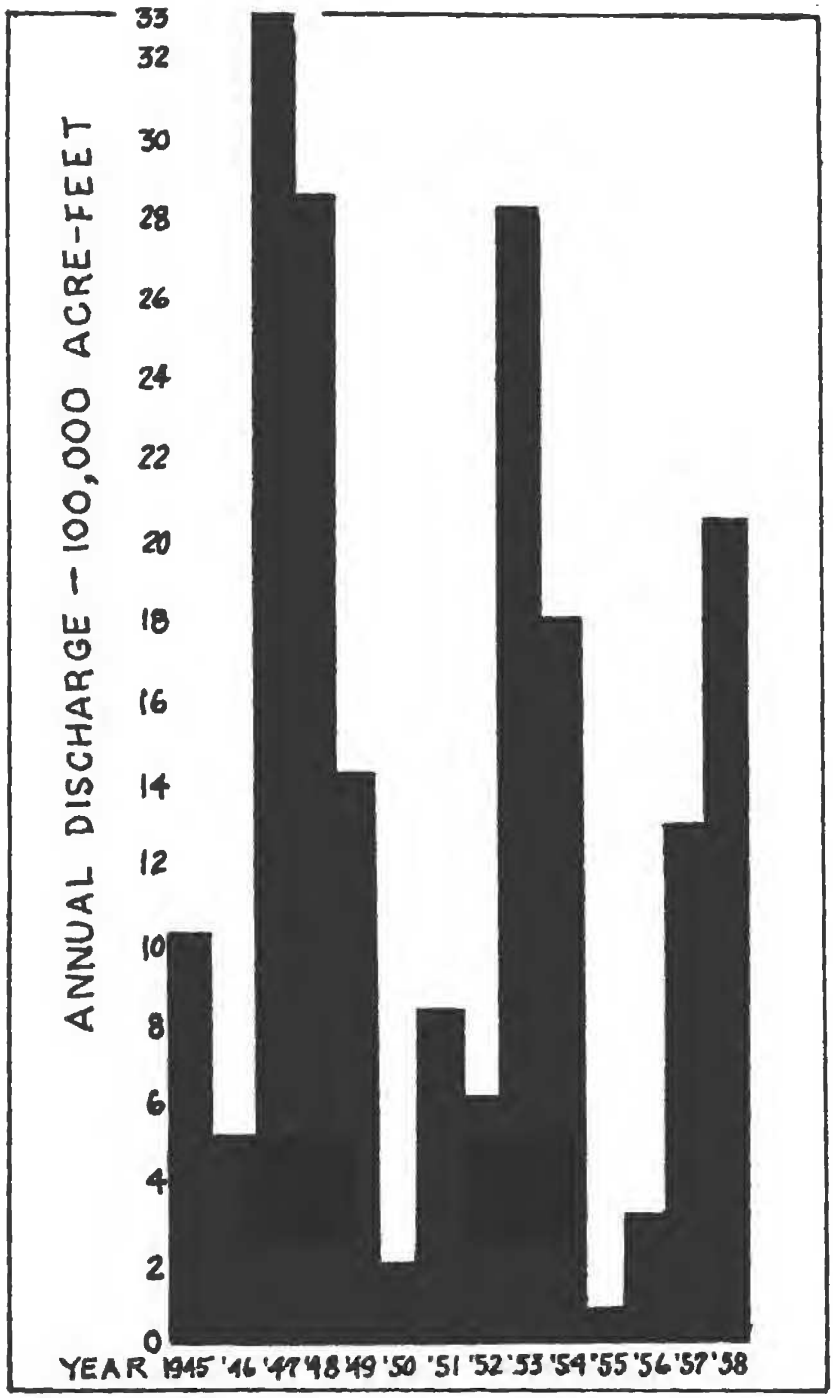


Plate 4 — Total annual discharges into the St. Lucie Estuary from all sources (1945-58).

and throughout the inner estuary and from 20.0 to 35.0 parts per thousand in the outer estuary. However, normal rain and runoff into either of the forks, or rain on the estuary itself, are likely to make the surface waters of the estuary temporarily fresh to below Stuart.

3. *Discharges in St. Lucie Estuary. — a. Through St. Lucie Canal.*— Reliable estimates of St. Lucie Canal discharge are available since April 1931 when the United States Geological Survey began operations in the canal. For the purposes of this report, estimated volumes of monthly flows from Lake Okeechobee since 1945 are given in table 2. Lake Okeechobee stages for the last day of the month during the same period are given in table 3. The total annual discharges of St. Lucie Canal at St. Lucie Lock and Dam, which include runoff in some years from the local drainage area, are depicted on plate 3 for the period 1945-58.

Although the capacity of St. Lucie Canal was almost doubled by the enlargement in 1949, caving banks and bottom filling since then have reduced the channel efficiency. The latest available rating curve gives maximum regulatory discharges from the lake through St. Lucie Canal for various lake stages as follows:

Lake Stage (ft.)	Regulatory discharge (c.f.s.)
13.5	5,500
15.0	6,600
15.5	6,950
16.5	7,800
17.5	8,800
18.0	9,300

Between 1945 and 1957, the years of prolonged heavy discharge from the lake were 1947-48 and 1953-54.

b. *From other areas.* — Discharge measurements over a period of record for the North Fork of St. Lucie River and other areas draining into St. Lucie Estuary are not available. However, the total annual runoff from the North and South Forks, exclusive of Lake Okeechobee releases, was estimated from rainfall. The estimated total annual dis-

TABLE 1

Total surface area, volume of water, and shoreline miles at mean low water in the three main sections of St. Lucie Estuary

Area	Surface area (acres)	Volume of water (acre-f·	Shoreline (miles)
South Fork			
Head of estuary to U. S. Hwy. 1 bridge	960	4,720	9.20
North Fork			
Kitching Cove to U. S. Hwy. 1 bridge	1,840	16,740	12.05
Main estuary			
U. S. Hwy. 1 bridge to Sewall Point	2,730	19,690	14.25
Total	5,530	41,150	35.50

TABLE 2

St. Lucie Canal
Estimated volumes of monthly discharges

Monthly discharge (1,000 acre-ft.)												
Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
13	10	16	17	18	24	15	16	91	343	258	15	836
31	15	130	87	11	18	8	8	10	109	16	21	464
22	3	116	224	90	106	290	320	310	402	410	394	2,687
350	316	290	232	38	24	10	14	90	356	352	336	2,408
140	4	2	1	1	1	1	32	384	324	—	—	890
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	397	130	—	527
—	—	—	—	—	—	—	—	—	184	267	—	451
—	—	—	—	—	—	—	351	463	578	499	514	2,405
206	—	—	—	63	310	387	357	107	39	—	—	1,469
—	—	—	—	—	—	—	—	—	—	—	3	3
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	46	90	—	85	385	253	—	—	859
204	335	234	367	330	129	148	99	26	—	—	—	1,872

TABLE 3

Lake Okeechobee stages for last day of month
1945-58

	Stage (ft.)												
Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yr. avg.
1945	13.2	13.0	12.9	12.1	11.6	11.7	12.6	13.2	15.5	15.8	15.4	15.5	13.5
1946	15.4	15.3	15.0	14.1	14.1	14.2	14.4	14.6	15.0	14.7	15.0	15.0	14.7
1947	14.8	14.8	15.3	14.8	14.5	15.2	15.7	15.9	17.9	18.7	18.4	17.4	16.1
1948	16.9	15.9	14.6	13.6	13.4	13.0	13.2	13.8	16.2	17.6	16.8	15.6	15.0
1949	14.7	14.1	13.5	13.1	12.6	13.1	13.6	14.6	14.8	14.7	14.8	15.2	14.1
1950	15.0	14.7	14.4	13.9	13.5	13.1	13.0	13.0	12.9	13.8	13.8	13.8	13.7
1951	13.6	13.5	13.1	13.1	12.9	12.8	13.2	13.7	13.9	15.6	15.1	15.0	13.8
1952	14.8	15.0	14.5	13.6	13.1	12.9	13.1	13.6	14.1	15.8	15.3	15.2	14.3
1953	15.2	14.9	14.2	13.7	12.9	13.3	13.9	14.2	16.0	17.6	17.0	16.1	14.9
1954	15.3	14.9	14.5	14.1	13.5	14.0	14.1	13.5	14.2	14.4	14.4	14.4	14.3
1955	14.4	14.3	13.8	13.5	12.9	13.5	13.5	13.5	13.6	13.3	13.0	12.8	13.5
1956	12.6	12.4	11.8	11.3	10.9	10.5	10.4	10.3	10.8	12.7	12.6	12.6	11.6
1957	12.9	12.9	13.2	13.4	13.6	13.3	13.5	13.9	14.9	14.7	14.8	15.5	13.9
1958	16.1	15.2	15.2	14.6	13.5	13.1	13.2	13.3	13.6	13.7	13.5	13.8	14.1
Period-of-record average since 1912	14.8	14.6	14.4	14.0	13.7	13.9	14.1	14.4	15.0	15.3	15.1	14.9	14.5

charges into St. Lucie Estuary from all sources, except rainfall on the estuary, during the period 1945-58 are shown on plate 4. During years when no lake waters are being released through St. Lucie Canal — such as 1950, 1955, and 1956 — the North Fork contributes most of the total discharge, and its effects are evident. In other years, the effects of discharge from the North Fork area are often masked by the greater discharge from St. Lucie Canal. Instantaneous peak flood flows into the estuary from the North Fork River alone have been estimated to be as high as 5,000 cubic feet a second and the total peak flows from all runoff into the North Fork may reach 9,000 cubic feet a second under existing conditions.

C. DISCUSSION OF THE PROBLEM

1. *Effects of fresh-water discharge.* — a. *Local contentions.* — Local interests in the Stuart area, primarily through the Stuart News and spokesmen for the St. Lucie-Indian Rivers Restoration League, have contended for many years that the release of turbid, fresh waters through St. Lucie Canal has caused serious damages to fishing, boating, and esthetic attractions in St. Lucie Estuary. In turn, the tourist industry, on which the economy of that community is said to depend, is alleged to suffer in years when winter discharges are made. Specific complaints of damage are many and varied.

2. *The sediment problem.* — a. *Available sediment data.* — In 1953 and 1954, the Jacksonville District conducted a study to determine the extent of the sedimentation problem in St. Lucie Estuary resulting from discharges through St. Lucie Canal. Analysis of the problem was based on data from previously available hydrographic surveys of St. Lucie Canal, River, and Estuary dating back to 1883 and other data as follows:

(1) A series of suspended-sediment samples taken between Port Mayaca and St. Lucie Inlet when full-capacity releases of the canal were being made.

(2) Secchi disk observations of turbidity at a number of locations between the lake and St. Lucie Inlet.

(3) Chemical and mineral analysis of samples of water flowing through St. Lucie Canal, as well as the amount of material in the water that would be flocculated upon mixing with sea water.

(4) Examination of the soils above the waterline along the banks of St. Lucie Canal and in the spillway outlet channels between Lake Okeechobee and St. Lucie Dam during full discharge conditions. Results of that study were presented in Part IV, Supplement 4, Design Memorandum, Effects of fresh-water discharges through St. Lucie Canal, dated 27 October 1954 (Jacksonville District). The sedimentation problem in the estuary resulting from St. Lucie Canal discharges, as indicated in Part IV, Supplement 4, and other sources, is summarized below.

b. *St. Lucie Canal.* — Lake Okeechobee water released through St. Lucie Canal carries fine sand, shell fragments, and organic material into St. Lucie Estuary. The very fine organic material and clay or muck usually suspended in the lake water gives it a dark, turbid appearance. When releases are being made, the turbid fresh water replaces portions of the salt water in the estuary. Although most of the fine material is carried into the ocean, some is deposited in places in the bay area where

velocities are very low or in the mixing zone of fresh and salt water, which causes the material to flocculate. Even though the major portion of the organic material carried from Lake Okeechobee by the releases is not deposited in the estuary, it is objectionable to the people in the area because the water appears dirty and turbid. In addition, some desirable sport fishes may leave the estuary when turbid water is released. Under high flow conditions, there is rather uniform turbidity between Lake Okeechobee and Stuart. When canal discharge is discontinued, turbid conditions in the estuary clear rapidly unless there is heavy runoff from other sources. The principal source of sand material carried by St. Lucie Canal is from bank caving in stretches of the canal between the dam and the lake. Only a minor amount of sediment enters the canal now at the fixed spillways because of the retarding action of the structures and thick cover of vegetation upstream. Increased agricultural development and erosion of farm drainage ditches are contributing to the sedimentation problem. The heavier sands picked up along the canal are deposited in the estuary as soon as the velocity slows. The principal shoaling area is in the South Fork in the vicinity of Palm City (plate 2) where the stream velocities are suddenly reduced by the wider bay area. Hydrographic surveys indicated the Palm City shoal contained 1,183,000 cubic yards more material in 1954 than in 1932. Channel dredging is required at intervals to restore navigable depths in that vicinity following prolonged periods of discharge. Between 1937 and 1954, hydrographic surveys indicated material was eroded from St. Lucie Estuary downstream from United States Highway 1 bridge at Stuart, showing that the majority of the sediment from St. Lucie Canal is not carried farther than the Palm City area.

c. *Other sources.* — Other streams and agricultural canals in St. Lucie and Martin Counties contribute to the sediment problem in St. Lucie Estuary. The North Fork Estuary receives sand from agricultural areas and some organic materials from swamps in St. Lucie County. Turbid waters from the North Fork area are in evidence far down the main estuary during runoff periods when St. Lucie Canal is not discharging. Secondary drainage canals in St. Lucie County are largely uncontrolled, as is the primary canal (Rim Ditch) leading into the North Fork of St. Lucie River. Under such conditions, sediment materials have been carried unimpeded to the mouth of the river where large sandbars and shoals have formed. Boat navigation from the estuary to the North Fork River has been affected by those shoals. The shoals are being removed in the construction of Canals 23A and 24 now in progress. Shoal areas are also found in the mouth of Bessey Creek emptying into the North Fork, and numerous shifting sandbars and shoals are located in the mouth of the main estuary near the inlet. The latter are believed by some local fishermen to be the result of St. Lucie Canal discharge. However, there is indication that little of the heavier sand material from St. Lucie Canal is carried that far down the estuary. Since those lower shoals are constantly shifting, it is more reasonable to consider that they are the result of storm-tide action on adjacent beaches and relocation of existing shoals through normal tidal action. Finally, sewage from a large portion of the local population is discharged into the estuary without treatment and no doubt adds to the sediment problem.

D. PRESENT INVESTIGATIONS

1. *Other agencies* — a. *United States Fish and Wildlife Service.* — Under the provisions of the Coordination Act (P.L. 732, 79th Cong., 1946), the Jacksonville District made funds available to the Fish and Wildlife Service for studies in the St. Lucie Estuary areas as follows:

(1) *Central and Southern Florida Project — St. Lucie County Canals (Canals 23, 23A, 24, and 25).* — The Service was requested to study the effects on fish and wildlife of the proposed improvement of those drainage canals to accelerate surface runoff of floodwaters into the North Fork Estuary and Fort Pierce Harbor. The field investigation was conducted during Fiscal Year 1957 (July 1956 to July 1957), the last year of a very dry period. An interim letter report was submitted in January 1957, and a second interim report was submitted April 22, 1959. The latter was a final report on all phases except the effects of discharge into the North Fork on the fishes and conditions of the main estuary. Annual damages resulting from the increased frequency of higher discharges into the North Fork, and based on future fisherman-use of that area with and without the project, were estimated to be $46,000.

(2) *Central and Southern Florida Project — Lake Okeechobee regulation.* — A 1-year comprehensive biological study of St. Lucie Estuary — with specific reference to the effects on estuarine fishes and animals and fishing, both sport and commercial — of Lake Okeechobee releases through St. Lucie Canal was conducted during Fiscal Year 1958. The reporting date was originally scheduled for December 31, 1958, but at the request of the Service was delayed until March 1, 1959. A report on that investigation has not been received.

b. *Florida State Board of Conservation,* which is concerned with the administration and conservation of marine fishes and animals, was requested by the Central and Southern Florida Flood Control District to investigate the effects of all project discharges into St. Lucie Estuary. A preliminary report containing numerous conclusions as to expected damages, but no basic biological data, was submitted to the Flood Control District in October 1957.

2. *Corps of Engineers.* — a. *General plan of investigation.* — The concept of the investigation was focused on the specific operational requirements of the project with sampling directed to identification of the important indicator species and what happened to them under various conditions related to the project. The foundation of the study was to be a comparison of the fishes, shellfishes, other aquatic organisms, and the physical conditions found at selected stations throughout the estuary in all seasons and under varying conditions of freshwater discharge from St. Lucie Canal. Since sport and commercial fish catches were to be included in studies of the Fish and Wildlife Service, emphasis in the district investigation was to be placed on the small food and bait fishes and animals and the young of sport and commercial fishes. Those groups are normal seasonal inhabitants of estuaries. Being more easily sampled than adult forms, they would furnish generally reliable indications of the temporary and permanent effects of physical changes in the estuarine environment, its inhabitants, and overall production. In addition, data on daily fishing pressure and fish catches below St. Lucie Lock and Dam were recorded to determine the effects of varying releases on that fishery.

Biological sampling, St. Lucie Estuary, 24 Feb. 1958. Fresh water discharge at St. Lucie Lock 4,800 c.f.s.; salinity in estuary less than 1 p.p.t.; turbidity (light penetration) less than 1 foot. Upper: Emptying trawl after 15-minute drag at station TS6. Lower: Portion of above trawl sample of fish and crabs at station TS6.

b. *Collection of basic data.* — (1) *Sampling gear and methods.* — Trawl samples were collected with a 20-foot otter trawl of 1-inch stretch mesh in the main trawl section and ½-inch stretch mesh in the bag. All trawl hauls were of 15-minute duration in water at least 7 feet deep. (See Figure 1). Seine samples were collected primarily with a 50-foot, ½-inch-mesh beach seine, the middle 25 feet of which was backed with bobbinet material. Occasional supplemental seine drags were taken with a 20-foot, ¼-inch-mesh minnow seine. Top and bottom water temperatures and water samples for salinity determination were taken along with each trawl and seine sample. Salinities in parts per thousand were determined from direct-reading salinity hydrometers with correction for temperature differences. In certain instances where the salinities in the water samples were too low for accurate determination with the hydrometers (Jan. 1957, Sept. 1957, and May 1958), total chlorinities were determined by titration by Dr. Robert Miller, Chemist, of Fort Pierce, Fla. Those values were later converted to total salinities. Light penetration or gross turbidity was measured in inches with a standard 12-inch weighted Secchi disk. All fishes and organisms collected in each trawl or seine haul were counted and measured according to species. Specimens whose identity could not be readily determined were preserved for later study at the Gulf Coast Research Laboratory.

(2) *Location and description of sampling stations.* — The approximate locations of the various trawl (TS) and seine (SS) stations are shown on plate 2; detailed station descriptions are given below.

(a) *Trawl stations.* — Seven trawl stations were selected — four in the inner estuary, near the head and mouth of both the South and North Fork sections, and three in the outer estuary. The outermost trawl station was located in the area farthest upstream from the inlet where some bottom salinity could be expected to be maintained by daily tidal action, even during the period of greatest fresh water discharge from St. Lucie Canal. Furthermore, that station was above the mouth of Indian River, a separate water system that also discharges into St. Lucie Inlet. The seven trawl stations are described as follows:

TS1 — In Channel above (south) Palm City bridge in the South Fork of St. Lucie River; depth, 9-11.5 feet; bottom — sand and muck; sand shoals on each side of channel.

TS2 — At the Y at mouth of South and North Forks between channel marker 24 and Highway 1 bridge; depth, 8.5-12 feet; bottom — muck and sand.

TS3 — Near head of North Fork of St. Lucie Estuary; depth, 7-10 feet; bottom — muck, sand, and detritus.

TS4 — Off the mouth of Bessey Creek in the North Fork of St. Lucie Estuary; depth, 9 feet; bottom — sand and muck.

TS5 — In channel north of Stuart and east of Highway 1 bridge, between beacons 22 and 23; depth, 8 feet; mud bottom with many dead *Mulinia* shells.

TS6 — In main estuary east of Stuart, at bend where river turns south near marker 21; depth, 9 feet; bottom — sand, mud, and detritus.

TS7 — Off Port Sewall in outer estuary between markers 14 and 15; depth, 10.5 feet; bottom — muck, trash, and vegetation.

Biological sampling with 50-foot beach seine, St. Lucie Estuary, February 1958. Upper: Seine station 3 in North Fork. Lower: Seine station 2 in outer estuary.

(b) *Seine stations.* — It was desired to have a complementary seine station on the shore adjacent to each trawl station. However, because of the rim of mangrove trees, especially in the North Fork, and other vegetation growing down into the water, suitable sites for beaching seines were scarce in the inner estuary (See fig. 2). In the outer estuary, residences were prevalent along the shorelines, and beaches were plentiful (Fig. 2). A total of six seine stations — three each in the inner and outer estuaries — was selected. Only trawl station No. 4 in the North Fork did not have a complementary adjacent seine station. From 1 to 3 seine drags, enough to get a representative sample of fish, were made if possible at each station during each sampling period. On two occasions, November 1957 and October 1958, exceptionally high waves and wind tides eliminated beaching sites and prevented sampling of some seine stations. The six seine stations are described as follows:

SS1 — Beach along Sewall Point on east shore of estuary; sand bottom with mangroves at edge of water; new station (SS1A; see below) used after first sample.

SS1A — Beach on west side of estuary near marker 14; sand, shells, and debris; residential area with palm trees and flowering shrubs, several boat docks.

SS2 — Beach on north shore of estuary opposite Stuart and east of Highway 1; sand bottom with some rocks.

SS3 — Small beach near head of North Fork Estuary on west shore; soft bottom with plants and debris; mangrove trees.

SS4 — Around shoals in South Fork above (south) Palm City bridge; hard-packed bottom, somewhat slick with algae and mud film; many dead *Rangia* shells.

SS5 — Beach in South Fork near Y on west shore opposite Stuart around point SW of marker 25; sand bottom.

SS6 — Beach at point in outer estuary NE of Stuart where river turns south; SW of marker 21 and TS6; sand bottom.

(3) *Extent of sampling during period of investigation.* — Sampling in the estuary was begun January 28-29, 1957, and continued periodically during various discharge conditions for the next 2 years. A total of 10 samples was taken during the 2-year period — 5 in 1957 (Jan., May, June, Sept., and Nov.), 4 in 1958 (Jan., Feb., May, and Oct.), and the final one in January 1959. During five of the sampling periods (Jan., May, and Nov. 1957; Oct. 1958; and Jan. 1959) there was no discharge from St. Lucie Canal. The discharge of lake water on the other occasions was as follows:

Discharge (c.f.s.)	Date
2,200	June 1957
6,600	Sept. 1957
7,380	Jan. 1958
4,000	Feb. 1958
5,200	May 1958

Fish samples in January of three different years on about the same dates (27-28), permitted comparative observations during a nondischarge period after 3 years of no discharge (1957); during a period of heavy discharge (1958); and during a nondischarge period, after a year of almost continuous fresh-water releases during most of the

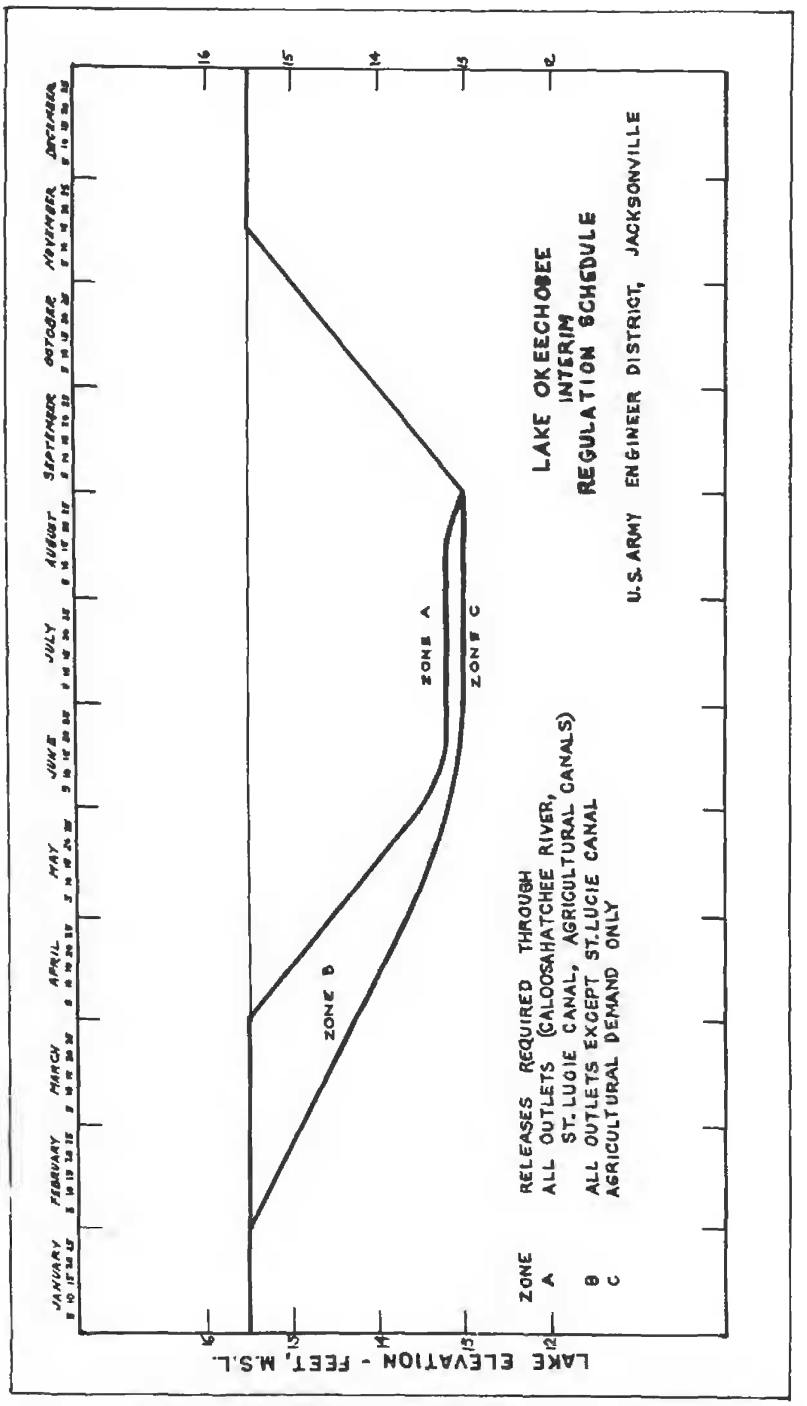
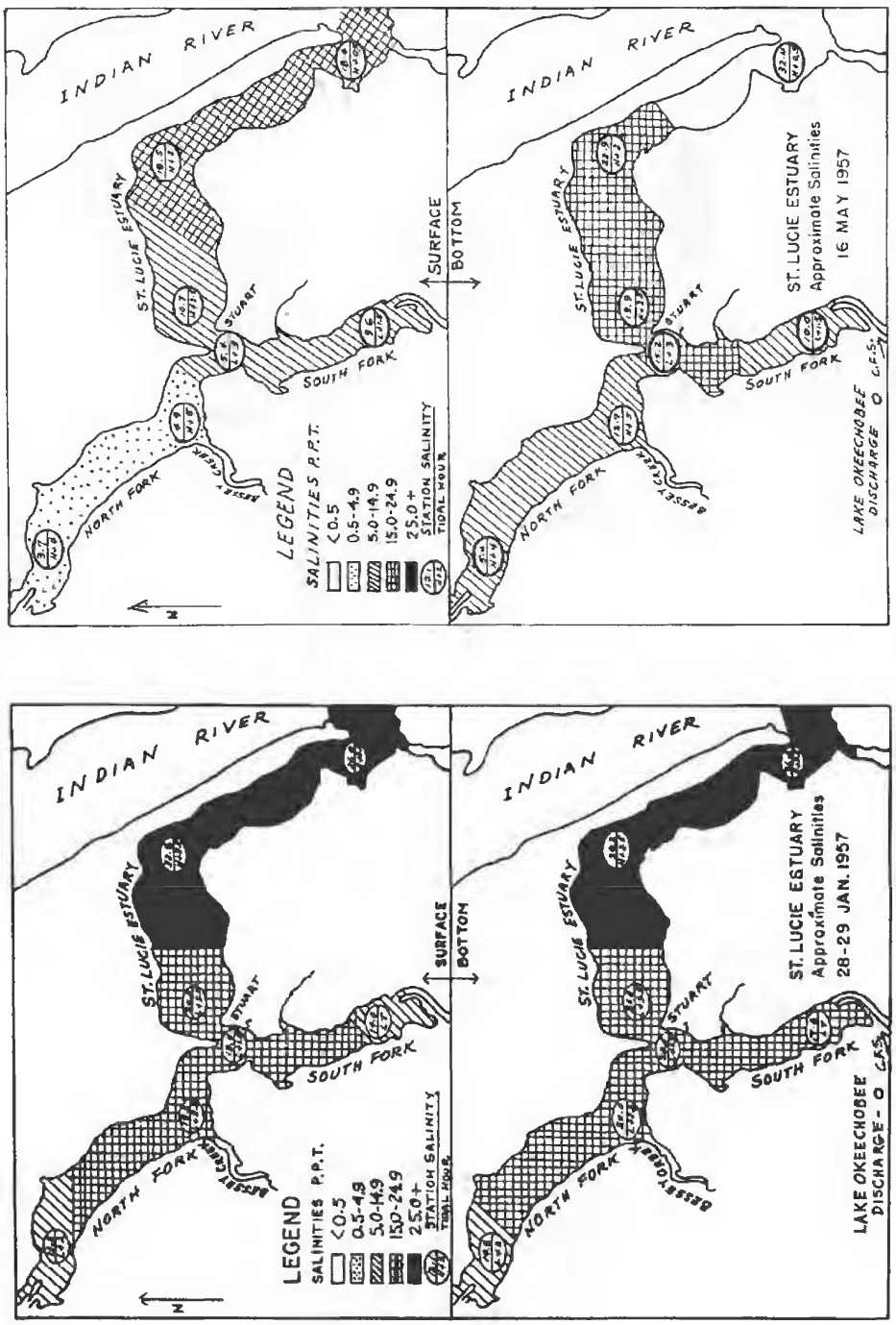
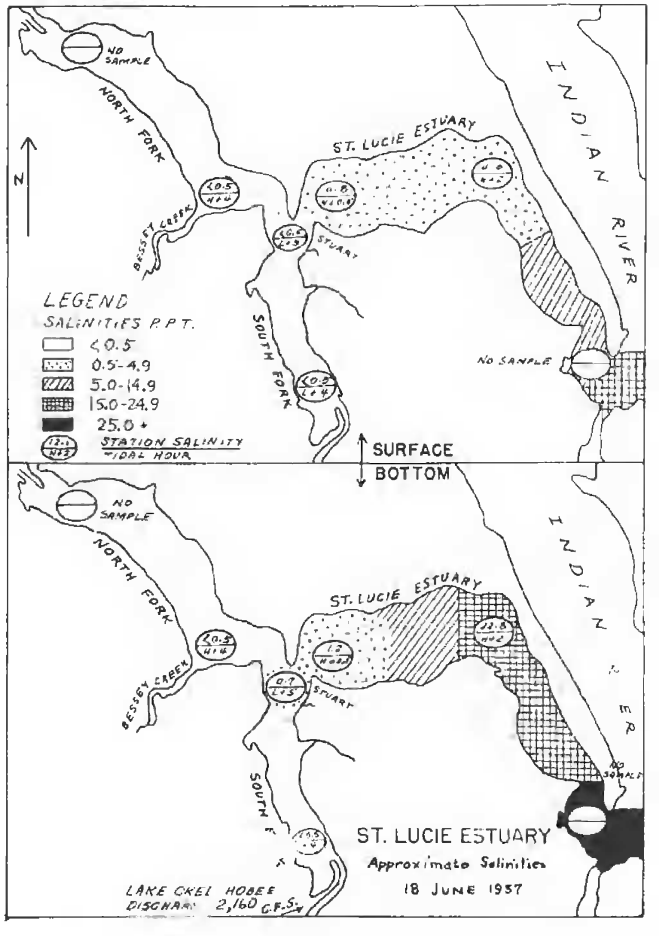
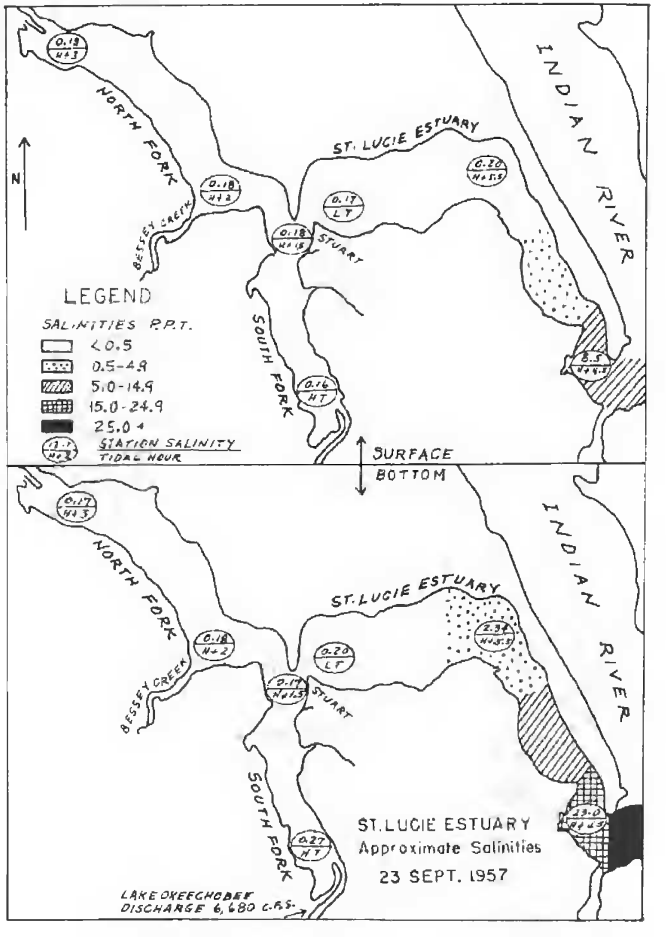


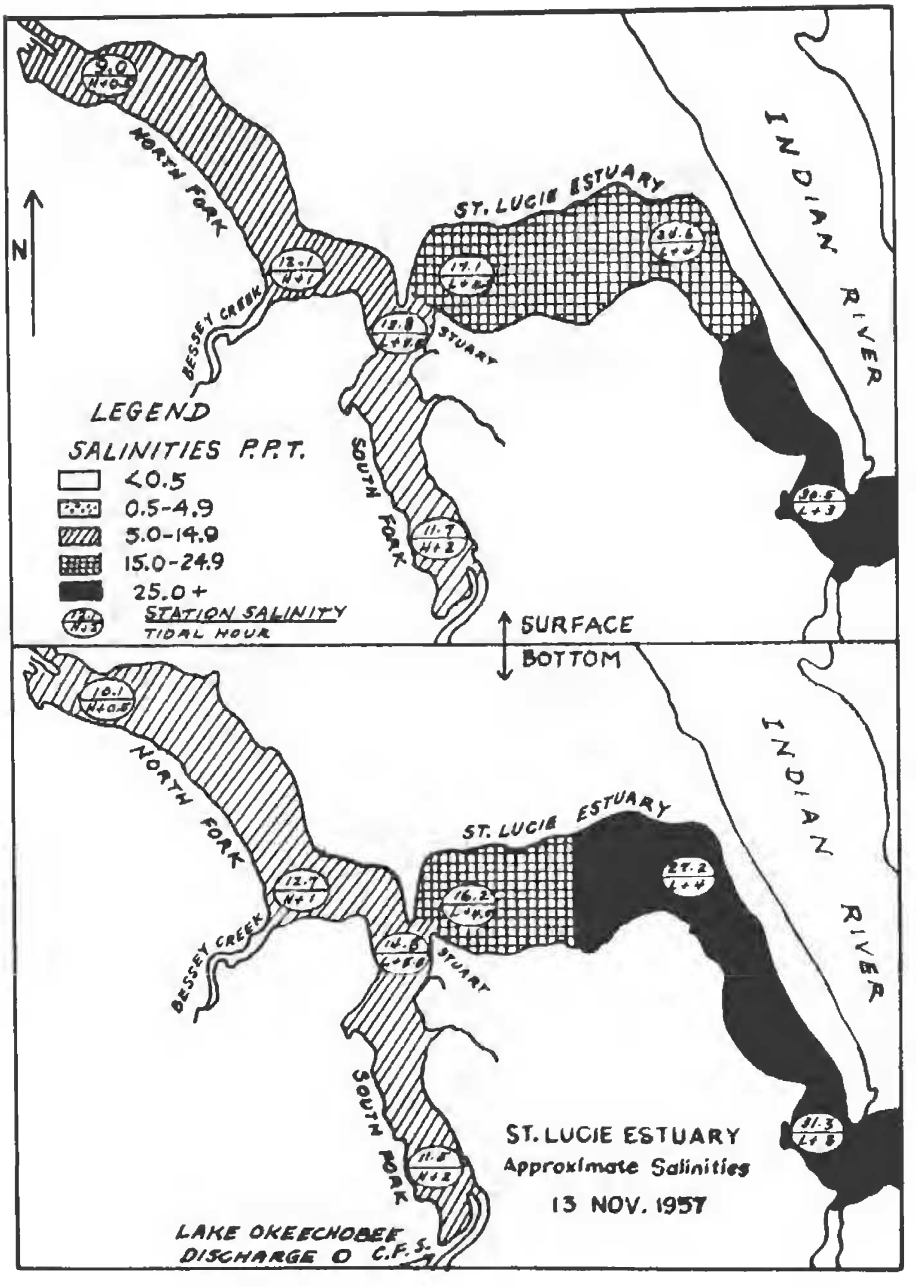
Plate 5 — The Lake Okeechobee regulation schedule in operation during the study period.

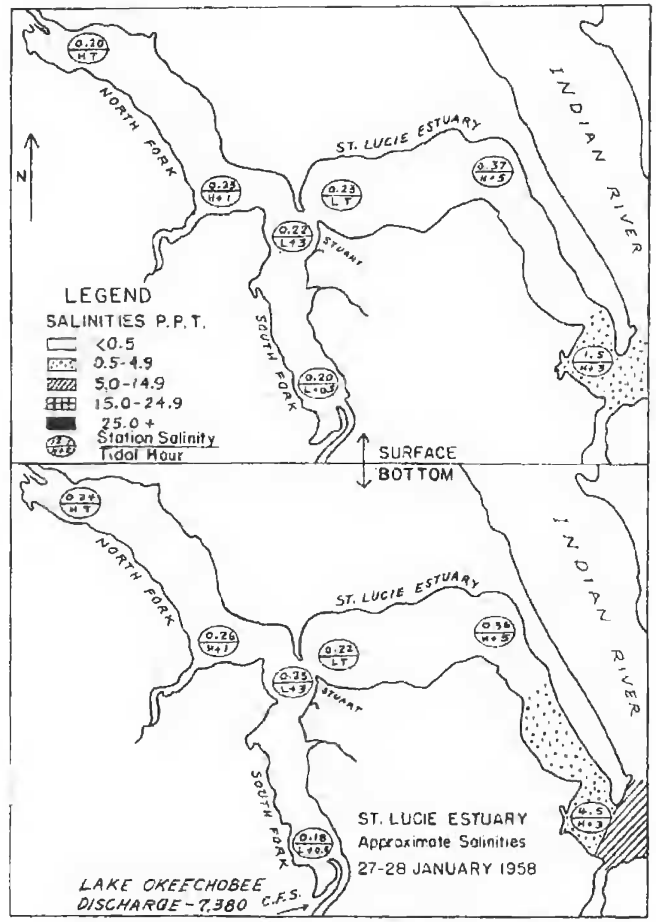


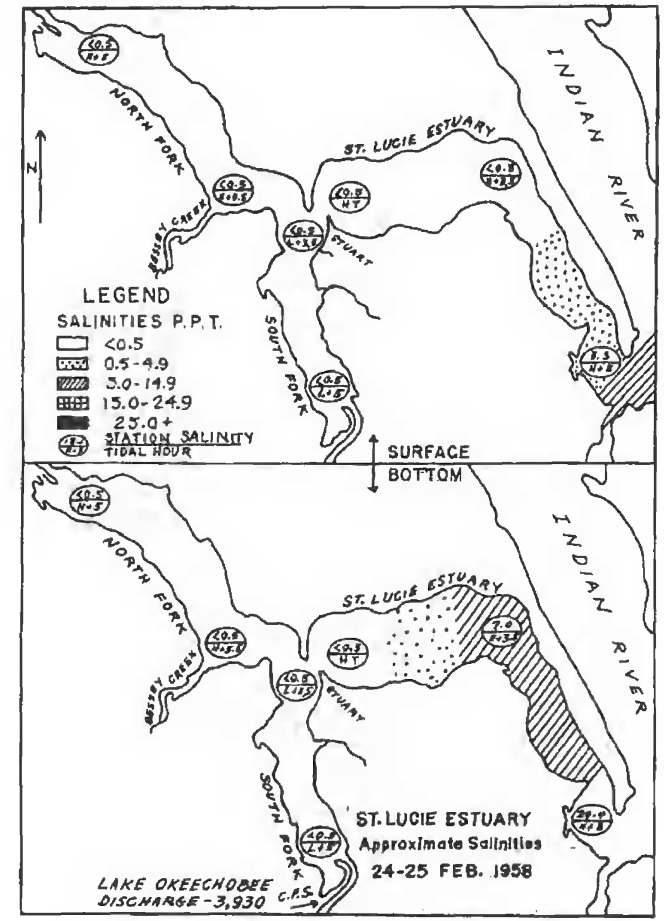
Plates 6 to 15 — Bottom and surface salinity characteristics of the St. Lucie Estuary at times of biological sampling.

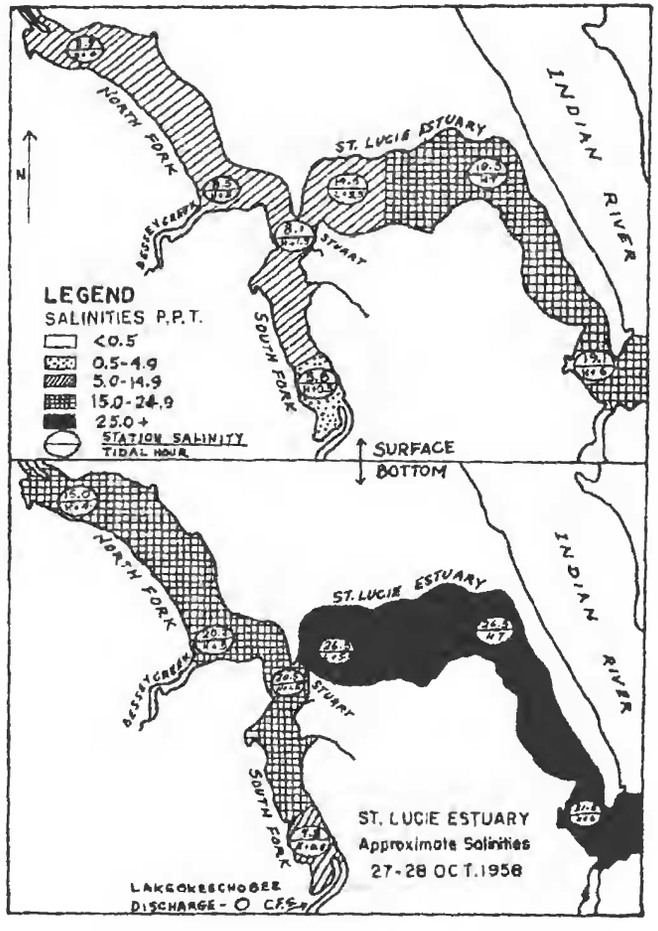

NO SAMPLE
NORTH FORK
BESSEY CREEK
ST. LUCIE ESTUARY
INDIAN RIVER
SOUTH FORK
N
LEGEND
SALINITIES P.P.T.
< 0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0 +
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
NO SAMPLE
NORTH FORK
BESSEY CREEK
ST. LUCIE ESTUARY
INDIAN RIVER
SOUTH FORK
ST. LUCIE ESTUARY
Approximate Salinities
18 JUNE 1957
LAKE OKEECHOBEE
DISCHARGE 2,160 C.F.S.

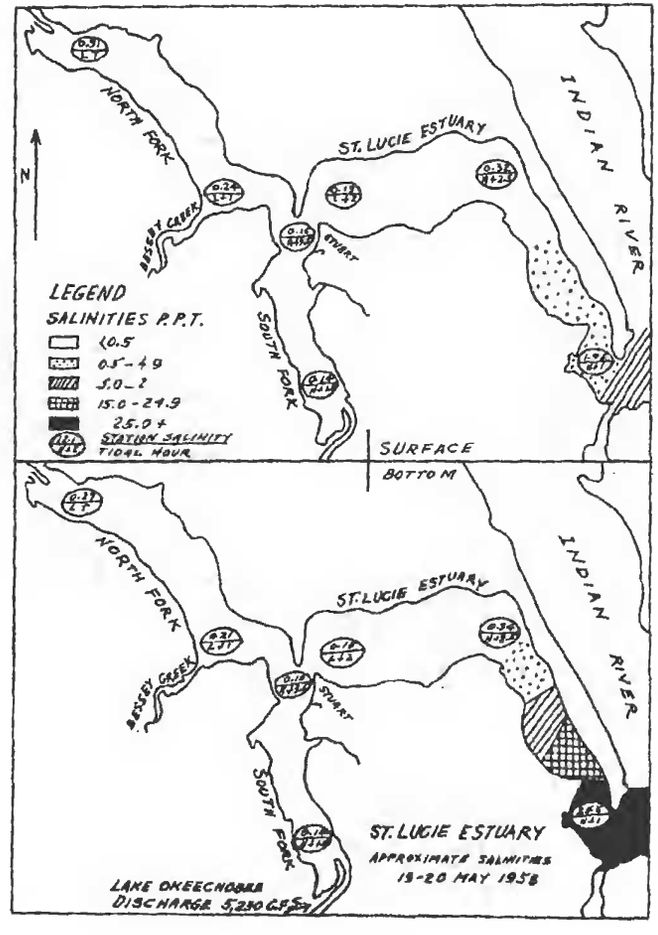

NORTH FORK
BESSEY CREEK
ST. LUCIE ESTUARY
INDIAN RIVER
SOUTH FORK
N
LEGEND
SALINITIES P.P.T.
< 0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0 +
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
NORTH FORK
BESSEY CREEK
ST. LUCIE ESTUARY
INDIAN RIVER
SOUTH FORK
ST. LUCIE ESTUARY
Approximate Salinities
23 SEPT. 1957
LAKE OKEECHOBEE
DISCHARGE 6,680 C.F.S.

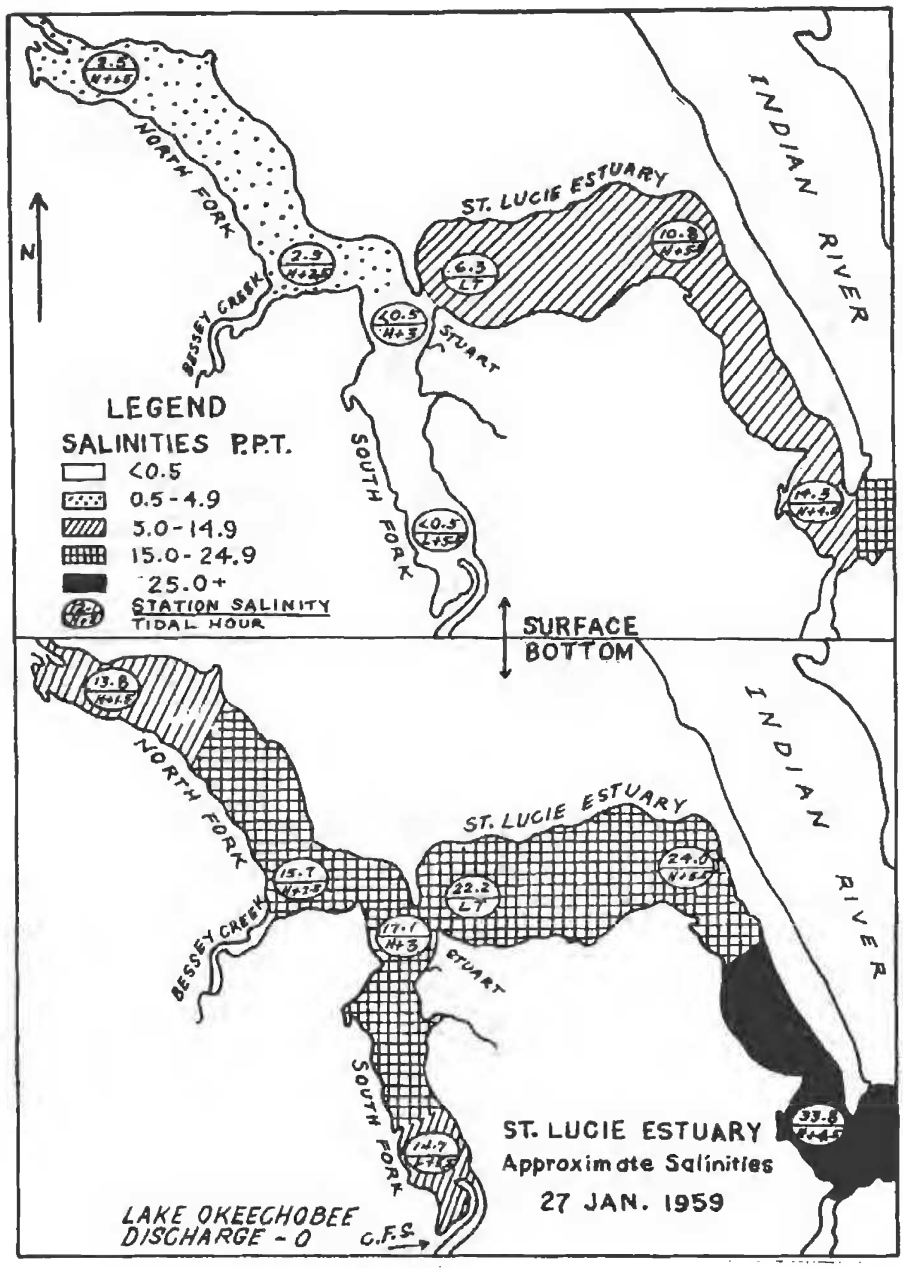

INDIAN RIVER
ST. LUCIE ESTUARY
NORTH FORK
SOUTH FORK
BESSEY CREEK
N
LEGEND
SALINITIES P.P.T.
<0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0+
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
ST. LUCIE ESTUARY
Approximate Salinities
13 NOV. 1957
LAKE OKEECHOBEE
DISCHARGE 0 C.F.S.


LEGEND
SALINITIES P.P.T.
<0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0+
Station Salinity
Tidal Hour
SURFACE
BOTTOM
N
NORTH FORK
ST. LUCIE ESTUARY
INDIAN RIVER
STUART
SOUTH FORK
ST. LUCIE ESTUARY
Approximate Salinities
27-28 JANUARY 1958
LAKE OKEECHOBEE
DISCHARGE - 7,380 C.F.S.


LEGEND
SALINITIES P.P.T.
<0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0+
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
N
NORTH FORK
ST. LUCIE ESTUARY
INDIAN RIVER
MOSQUITO CREEK
STUART
SOUTH FORK
ST. LUCIE ESTUARY
Approximate Salinities
24-25 FEB. 1958
LAKE OKEECHOBEE
DISCHARGE - 3,930 C.F.S.


NORTH FORK
ST. LUCIE ESTUARY
INDIAN RIVER
BESSEY CREEK
STUART
SOUTH FORK
N
LEGEND
SALINITIES P.P.T.
<0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0+
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
ST. LUCIE ESTUARY
Approximate Salinities
27-28 OCT. 1958
LAKE OKEECHOBEE
DISCHARGE - 0 C.F.S.


NORTH FORK
ST. LUCIE ESTUARY
INDIAN RIVER
BESSEY CREEK
STUART
SOUTH FORK
N
LEGEND
SALINITIES P.P.T.
<0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0+
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
ST. LUCIE ESTUARY
APPROXIMATE SALINITIES
19-20 MAY 1958
LAKE OKEECHOBEE
DISCHARGE 5,230 C.F.S.


NORTH FORK
ST. LUCIE ESTUARY
INDIAN RIVER
N
BESSEY CREEK
STUART
SOUTH FORK
LEGEND
SALINITIES P.P.T.
<0.5
0.5-4.9
5.0-14.9
15.0-24.9
25.0+
STATION SALINITY
TIDAL HOUR
SURFACE
BOTTOM
NORTH FORK
ST. LUCIE ESTUARY
INDIAN RIVER
BESSEY CREEK
STUART
SOUTH FORK
ST. LUCIE ESTUARY
Approximate Salinities
27 JAN. 1959
LAKE OKEECHOBEE
DISCHARGE - 0
C.F.S.

spawning and growing period. The total number of trawl and seine hauls taken in the three main sections of the estuary during each sampling period is given in table 4.

E. PHYSICAL CONDITIONS DURING STUDY PERIOD

1. *Fresh water discharge into St. Lucie Estuary.* — a. *From Lake Okeechobee.* — Lake Okeechobee stages on the last day of the month for 1957 and 1958 are given in table 3. The lake-regulation schedule in use at that time (plate 5) operated the lake levels seasonally between 12.5 nd 15.5 feet. Under that schedule, discharges were required through St. Lucie Canal whenever the lake elevation was in Zone A. It was also

TABLE 4

The number of hauls with different gear in South Fork, North Fork, and outer St. Lucie Estuary for each collection period

Item	Collection period and number of hauls										
	1957					1958				1959	
	Jan.	May	June	Sept.	Nov.	Jan.	Feb.	May	Oct.	Jan.	Total
Trawl											
Inner estuary											
South Fork	2	2	2	2	2	2	2	2	2	2	20
North Fork	2	2	1	2	2	2	2	2	2	2	19
Subtotal	4	4	3	4	4	4	4	4	4	4	39
Outer estuary	3	3	2	3	3	3	3	3	3	3	29
Total	7	7	5	7	7	7	7	7	7	7	68
Beach seine (50 ft.)											
Inner estuary											
South Fork	5	4	5	4	1	2	3	2	0	2	28
North Fork	3	2	0	3	2	3	1	1	1	0	16
Subtotal	8	6	5	7	3	5	4	3	1	2	44
Outer estuary	6	6	3	6	5	3	4	7	4	3	47
Total	14	12	8	13	8	8	8	10	5	5	91
Minnow seine (20 ft.)											
Inner estuary											
South Fork	—	—	2	—	—	—	—	—	0	0	2
North Fork	—	—	0	—	—	—	—	—	2	2	4
Subtotal	—	—	2	—	—	—	—	—	2	2	6
Outer estuary	—	—	6	—	—	—	—	—	0	0	6
Total			8						2	2	12
Grand total	21	19	21	20	15	15	15	17	14	14	171

necessary that the lake level be lowered to 13.0 feet by June 30, prior to the hurricane season. The average daily rates of discharge through St. Lucie Lock and Dam during 1957 and 1958 are given in tables 5 and 6.

TABLE 5

St. Lucie Canal at St. Lucie Lock and Dam Discharges, 1957
(Regulatory releases from Lake Okeechobee)

Date	Average daily discharge (c.f.s.)					
	May	June	Aug.	Sept.	Oct.	
1		2,200		5,100	6,830	
2		2,210		5,110	6,920	
3		2,210		5,090	7,400	
4		2,210		5,100	7,260	
5		2,210		5,480	7,080	
6		2,210		6,020	6,920	
7		2,210		5,010	6,840	
8		2,200		7,000	6,830	
9		2,220		6,750	7,050	
10		2,220		7,030	7,070	
11		2,210		6,780	6,980	
12		2,190		6,690	6,900	
13		2,190		6,630	6,820	
14		2,190		6,640	6,950	
15		2,180		6,870	6,990	
16	*	2,170	570	6,990	6,410	
17	330	2,170	1,690	6,920	5,800	
18	660	2,160*	2,240	6,890	3,610	
19	660	2,170	2,150	6,840	2,350	
20	910	2,170	2,240	6,870	2,330	
21	1,140	1,090	2,250	6,790	1,310	
22	1,140		2,260	6,720		
23	1,130		2,270	6,680*		
24	1,470		2,270	6,670		
25	2,220		2,280	6,630		
26	2,230		2,270	6,580		
27	2,230		2,620	6,590		
28	2,220		4,000	6,570		
29	2,210		4,320	6,600		
30	2,210		4,290	6,820		
31	2,210		4,820			
Total:	22,970	44,990	42,540	192,460	126,650	Total — 1957
Day-second-feet	45,940	89,980	85,080	389,920	253,300	429,610
Acre-feet						859,220
Days	15	21	16	30	21	
Accumulative total	15	36	52	82	103	

NOTE: *Biological sampling day.

TABLE 6

St. Lucie Canal at St. Lucie Lock and Dam Discharges, 1958
(Regulatory releases from Lake Okeechobee)

Date	Average daily discharge (c.f.s.)								
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1	—	7,190	3,450	5,830	5,750	4,820	—	2,510	1,580
2	—	7,200	3,460	6,360	5,700	4,820	850	2,500	1,580
3	—	7,100	3,470	6,370	5,680	4,780	2,530	2,500	1,580
4	—	6,970	3,440	6,380	5,700	4,700	2,540	2,190	1,580
5	—	6,850	3,410	6,360	5,700	4,700	2,530	1,570	1,590
6	—	6,810	3,420	6,360	5,820	4,720	2,520	1,570	1,590
7	—	6,850	3,440	6,350	5,940	4,710	2,510	1,560	1,600
8	—	6,940	3,440	6,240	5,750	4,650	2,500	1,560	1,600
9	630	6,770	3,440	6,100	5,570	4,600	2,500	1,560	1,060
10	1,870	6,720	3,450	6,050	5,490	4,560	2,490	1,570	
11	2,790	6,710	3,420	6,400	5,590	4,420	2,500	1,570	
12	3,070	6,700	3,420	6,470	5,710	3,370	2,510	1,580	
13	3,090	6,790	3,470	6,300	5,600	2,820	2,510	1,580	
14	3,090	6,620	3,490	6,080	5,420	2,470	2,520	1,560	
15	3,090	6,690	3,470	5,810	5,330	2,500	2,520	1,580	
16	3,130	6,780	3,450	6,070	5,350	1,670	2,530	1,580	
17	3,110	6,620	3,440	5,840	5,290		2,530	1,590	
18	3,090	6,540	3,450	5,920	5,230		2,530	1,590	
19	3,060	6,280	3,470	6,150	5,230*		2,530	1,210	
20	3,540	5,960	3,480	6,100	5,090*		2,540	840	
21	4,200	5,420	3,520	6,080	4,940		2,530	840	
22	4,230	4,815	3,470	6,100	4,900		2,530	840	
23	4,200	4,440	3,420	6,160	4,860		2,530	1,350	
24	5,060	3,930*	3,430	6,100	4,910		2,530	1,600	
25	7,220	3,460*	3,815	6,060	5,000		2,520	1,600	
26	7,450	3,470	4,890	6,010	4,990		2,510	1,610	
27	7,380*	3,500	5,110	5,930	4,910		2,500	1,610	
28	7,250*	3,480	5,150	5,880	4,900		2,490	1,600	
29	7,200		5,070	5,860	4,960		2,500	1,590	
30	7,200		5,030	5,830	4,900		2,500	1,590	
31	7,100		5,210		4,830		2,500	1,580	
Total:									Total - 1958
Day-second-ft.	102,050	167,605	117,095	183,550	165,040	64,310	73,830	49,580	13,760	936,820
Acre-ft.	204,100	335,210	234,190	367,100	330,080	128,620	147,660	99,160	27,520	1,873,640
Days	23	28	31	30	31	16	30	31	9	
Accumulative total	23	51	82	112	143	159	189	220	229	

NOTE: *Biological sampling day.

TABLE 7

Number of samples, range, and average of all salinity readings in South Fork, North Fork, and outer estuary for each sampling period (Readings in parts per thousand)

Date	Lake discharge	South Fork				North Fork				Outer estuary			
		Surface		Bottom		Surface		Bottom		Surface		Bottom	
	(c.f.s.)	No. of samples	Range & average	No. of samples	Range & average	No. of samples	Range & average	No. of samples	Range & average	No. of samples	Range & average	No. of samples	Range & average
1957													
Jan. 28-29	0	4	14.0-19.3 (17.3)	2	17.0-20.8 (18.7)	3	13.8-18.5 (15.4)	2	14.8-20.0 (17.4)	5	20.0-32.8 (25.6)	2	29.2-36.0 (32.6)
May 16	0	4	5.4-9.6 (7.6)	2	10.0-15.2 (12.6)	3	3.7-4.9 (4.1)	2	5.4-12.7 (9.0)	5	10.7-21.5 (17.7)	3	19.9-32.4 (25.1)
June 18	2,160	4	<1.0 (<1.0)	2	<1.0 (<1.0)	1	<1.0 (<1.0)	1	<1.0 (<1.0)	4	0.8-4.0 (2.2)	2	1.2-22.8 (12.0)
Sept. 23	6,680	4	0.16-0.17 (0.17)	2	0.17-0.27 (0.22)	3	0.17-0.18 (0.18)	2	0.17-0.18 (0.18)	6	0.17-8.5 (2.8)	3	0.20-23.0 (8.5)
Nov. 13	0	3	11.7-14.5 (13.3)	2	11.5-14.8 (13.2)	3	5.2-12.1 (8.8)	2	10.1-12.7 (11.4)	5	17.1-30.5 (25.0)	3	16.2-31.3 (24.9)
1958													
Jan. 27-28	7,380	4	0.20-0.35 (0.25)	2	0.18-0.23 (0.21)	3	0.20-0.26 (0.23)	2	0.24-0.26 (0.25)	6	0.23-1.54 (0.63)	3	0.22-4.50 (1.69)
Feb. 24-25	4,000	4	<1.0 (<1.0)	2	<1.0 (<1.0)	3	<1.0 (<1.0)	2	<1.0 (<1.0)	6	<1.0-4.9 (1.7)	3	<1.0-29.4 (12.3)
May 19-20	5,200	4	0.14-0.15 (0.14)	2	0.14 (0.14)	3	0.14-0.31 (0.23)	2	0.21-0.27 (0.24)	6	0.15-1.42 (0.57)	3	0.15-25.5 (8.7)
Oct. 27-28	0	2	3.8-8.1 (6.0)	2	7.8-20.3 (14.1)	3	7.8-8.5 (8.3)	2	15.0-20.2 (17.6)	6	14.0-27.4 (18.9)	3	26.3-31.5 (28.0)
1959													
Jan. 27	0	4	<1.0 (<1.0)	2	14.7-17.1 (15.9)	3	2.4-2.6 (2.5)	2	13.8-15.7 (14.8)	6	6.3-25.9 (12.3)	3	22.2-33.8 (26.7)

local runoff from the North Fork. On all occasions of lake discharge, there was still bottom salinity at the outermost station of the estuary (TS7), which is considerable distance upstream from the inlet. The lowest bottom reading at that station was 4.5 parts per thousand when 7,380 cubic feet a second was being released through St. Lucie Canal. On other occasions of high discharges (above 4,000 c.f.s.), the bottom salinity at station 7 was much higher — for example:

Discharge (c.f.s.)	Bottom Salinity (p.p.t.)
6,680	23.0
5,200	25.5
4,000	29.4

Under normal conditions, the range of salinity from surface to bottom at the same point would often vary 5.0 to 10.0 parts per thousand in the inner estuary, probably as a result of local rainfall and light surface runoff. In the outer estuary, the difference in top and bottom salinities was on occasion more than 10.0 parts per thousand because of the interaction of fresh water runoff with certain tidal stages. Salinities in the inner estuary ranged from near 0 top and bottom with either lake discharge or local runoff to 5.0-20.0 parts per thousand under normal conditions. A greater range of salinities was found in the outer estuary, from near fresh to full sea strength, with various discharge conditions, but the bottom salinities were less affected by fresh water runoff than the inner stations because the salt front remained in that area. The range of normal salinities in the outer estuary was generally from 15.0 to 30.0 parts per thousand at the upper stations and from 25.0 to 35.0 parts per thousand at the lower ones.

3. *Turbidities.* — The Secchi disk readings taken at various stations during each sampling period are summarized here in table 8. The turbidity readings measured during the investigation substantiated the conclusion of previous studies that the turbidity in the estuary varied with the lake discharge and local runoff. On most occasions, the turbidity increased directly with higher rates of lake discharge. However, it was less in September 1957 with 6,680 cubic feet a second discharge than in May of that year when no releases were being made and in June 1957 when only 2,160 cubic feet a second was being released. High winds and wave action in both Lake Okeechobee and the estuary, which keep sediment materials stirred up, are considered responsible for high turbidities at certain times. Turbid waters fom Lake Okeechobee did not appear to penetrate too far into the North Fork, since on several discharge occasions when the waters in the South Fork and main estuary were clear to depth of less than 1 foot, turbidity readings were 1.5 to 3 feet higher in the North Fork of the estuary. The highest turbidities were observed in January 1958. With maximum discharge of 7,380 cubic feet a second at that time, turbidities in the outer South Fork and estuary were 6 to 10 inches. Normal turbidities in the inner estuary appear to be 30 to 40 inches and in the outer estuary 36 to 60 inches. A fathometer survey conducted in October 1957 for the purpose of determining changes in depths of bottom sediments in the estuary since 1954 gave inconclusive results in that respect, although there was no evidence of appreciable deposition in the area. Slight deposition of materials in some sections apparently resulted from erosion of other reaches nearby. The mineral content of a composite water sample from St. Lucie Canal

(Sept. 11, Oct. 3, and Oct. 15, 1957) at St. Lucie Lock and Dam is listed in table 9. It shows that the total nitrogen content of the water coming into St. Lucie Estuary through St. Lucie Canal was 0.8 parts per million. In other analyses of St. Lucie waters by the United States Geological Survey, the nitrate content (NO_3) through the years has varied from a trace to 2.0 parts per million. On the basis of 0.8 parts per million, there were 987 tons of nitrogen nutrients discharged into the estuary in 1957 and 2,040 tons in 1958 by way of St.Lucie Canal.

TABLE 8

Range and average turbidity readings in the South Fork, North Fork, and outer estuary for each sampling period

Month	Lake discharge (c.f.s.)	Turbidity reading (inches) South Fork	North Fork	Outer estuary
1957				
Jan.	0	36	54	60
May	0	24	24	24
June	2,160	12-15 (13.5)	24	22-30 (27
Sept.	6,680	28	29	26-27 (26.5)
Nov.	0	No readings because of loss of disk		
1958				
Jan.	7,380	6-12 (8)	22-31 (25)	9-12 (10)
Feb.	4,000	11-12 (11)	50	12
May	5,200	16-21 (18)	14-24 (21)	12-14 (14)
Oct.	0	34-38 (36)	42-48 (45)	36-48 (41)
1959				
Jan.	0	28-31 (30)	36	36-40 (38)

TABLE 9

Mineral content of composite water sample from St. Lucie Canal at St. Lucie Lock and Dam (Sept. 11, Oct. 3, and Oct. 15, 1957)

pH	8.1
Item	Parts per million
Dissolved solids	194
Calcium as Ca	32
Magnesium as Mg	8
Sodium and potassium as Na	16
Iron as Fe (soluble)	0
Silica as SiO	5
Sulfates as SO_4	20
Chlorides as Cl	30
Nitrogen as N	0.8
Phosphorus	0
Alkalinity (methyl orange) as $CaCO_3$	85
(phenolphthalein) as $CaCO_3$	0
Total hardness as $CaCO_3$	113
Carbonate hardness as $CaCO_3$	85
Noncarbonate hardness as $CaCO_3$	28
Free carbon dioxide as CO_2	0

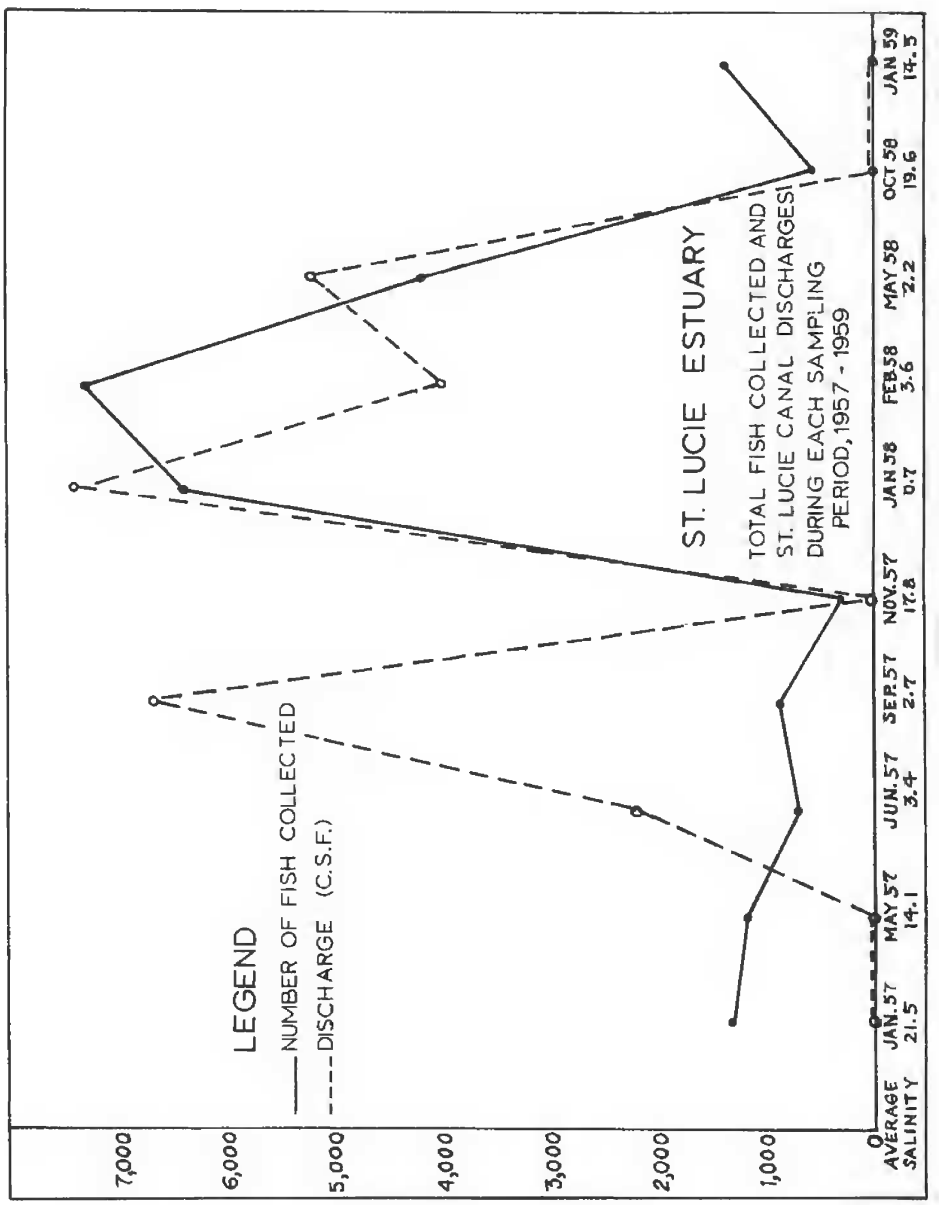


Plate 16 — The numbers of fishes caught during the investigations and the discharge through the St. Lucie Canal at the same periods.

4. *Temperatures.* — a. *Water.* — The range and average of the surface and bottom water temperatures measured at each sampling station are summarized for all stations for each period in table 10.

In 1957, the average water temperatures in the estuary samples varied from a low of 70.5° in November to a high of 87.6° in September. In comparison, 1958 was much colder, with lows of 59° and 58° in January and February respectively. The surface and bottom water temperatures averaged 13° colder in January and 5° colder in May 1958 than in 1957. Surface waters generally averaged a few tenths to 3 degrees warmer than the bottom waters, except in October and November when the reverse condition occurred. The year 1959 was milder than 1958 but not as mild as 1957.

b. *Air.* — The average daily maximum and minimum air temperatures at Stuart, for the three winter periods of this investigation (Nov. through Feb. 1956-57, 1957-58, and 1958-59), were extracted from Climatological Data for Florida and are summarized in table 11. The winter of 1956-57 was a mild season, with no freezing days during the 4 month period. Only five times — 3 in November and 2 in December — did the temperature reach 40° or below. The lowest January temperature was 42° on one day, and once in February it went down to 44°. The average maximum and minimum daily temperatures between October and March were about 78° and 58° respectively. In contrast, the winter of 1957-58 after November was an exceptionally cold year for all of Florida. Freezing temperatures were recorded at Stuart on 6 days — once in December, twice in January, and three times in February. Temperatures below 40° were recorded 16 times during the December-February period, 9 of which were in February. Maximum temperatures averaged 10° and 12° colder in January and February 1958 than in 1957; minimum temperatures averaged 6° and 16° colder, respectively. That exceptionally cold winter resulted in heavy losses of tourist business throughout central and southern Florida. The winter of 1958-59 was again a comparatively mild period, and, in November and February, was warmer on the average than the 1956-57 season. In contrast to the previous year, the minimum daily February temperature averaged 20° warmer in 1959 than in 1958.

5. *Summary of physical conditions in the estuary during the study period.* — The period of the investigation was one of contrasting physical conditions. The winter and spring collections in 1957 were made when there had been no freshwater discharge from Lake Okeechobee for 3 years. Salinities were high and temperatures mild. There was a heavy discharge period that fall, but none from mid-October to January. In 1958, except for brief periods, discharges were moderate to heavy throughout the winter and spring and low to moderate throughout the summer until early September. The inner waters were fresh and turbid and the outer waters of low salinity in accordance with the discharge. The winter of 1957-58 was abnormally cold, with several freezes. There was no discharge, and salinities and temperatures were high from September 1958 until the end of the study in January 1959. Salinities during the period ranged from zero to 20.5 in the inner estuary and from zero to 36.0 parts per thousand in the outer estuary. Water temperatures ranged from 59.0° to 87.6° and turbidities from 6 inches to 5 feet. Low salinities in the estuary, as result of local runoff from the North Fork watershed, were experienced on several occasions when no lake water was being released. Fish samples were collected on five occasions

when there were no lake discharges and five when the rate of release ranged from 2,160 to 7,380 cubic feet a second.

TABLE 10

Number of readings, range, and surface and bottom water temperatures for all stations during each collection period (Readings in degrees Fahrenheit)

Date	Surface			Bottom			
	No. of Readings	Range	Average	No. of Readings	Range	Avg.	Grand Avg.
1957							
Jan. 27	12	73.6-76.8	74.8	7	72.0-76.1	74.4	74.6
May 16	12	79.9-87.3	83.1	7	78.3-80.1	79.5	81.7
June 18	7	82.6-86.5	85.0	5	82.6-84.7	83.5	84.3
Sept. 23	12	82.6-87.6	85.0	6	73.2-82.6	76.8	82.2
Nov. 13	10	70.9-71.8	71.2	7	70.5-71.8	71.5	71.3
1958							
Jan. 28	9	59.0-63.9	61.7	5	59.9-62.2	61.2	61.5
Feb. 24	13	58.0-70.0	62.5	7	58.0-66.0	60.4	61.7
May 19	13	76.0-80.0	78.2	7	76.0-81.0	77.8	78.0
Oct. 27	11	72.0-78.0	75.3	7	74.0-78.0	75.7	75.5
1959							
Jan. 27	13	68.0-74.0	70.9	7	66.0-72.0	68.0	69.9

TABLE 11

Range and average of maximum and minimum daily air temperatures at Stuart, November through February 1956-57, 1957-58, and 1958-59

Month	Daily air temperature (degrees Fahrenheit)			
	Maximum		Minimum	
	Range	Average	Range	Average
Nov. 1956	69.0-84.0	77.5	34.0-73.0	58.0
Dec. 1956	62.0-87.0	77.1	36.0-70.0	56.6
Jan. 1957	69.0-83.0	77.6	42.0-68.0	56.2
Feb. 1957	73.0-85.0	79.0	44.0-71.0	61.2
Nov. 1957	72.0-87.0	80.6	51.0-72.0	65.1
Dec. 1957	56.0-82.0	74.1	29.0-71.0	55.9
Jan. 1958	50.0-78.0	67.6	30.0-64.0	50.0
Feb. 1958	53.0-85.0	66.9	30.0-68.0	45.1
Nov. 1958	74.0-90.0	83.6	56.0-74.0	67.7
Dec. 1958	65.0-83.0	74.7	41.0-71.0	57.2
Jan. 1959	59.0-85.0	72.5	33.0-69.0	54.1
Feb. 1959	72.0-88.0	81.1	58.0-72.0	64.9

F. RESULTS OF BIOLOGICAL SAMPLING

1. *The fish catch.* — Table 12 shows that 83 species of fishes were taken during this investigation. Seventeen were fresh-water species; the remainder were marine. The separation is made on the basis of spawning locality — that is, in fresh or salt water.

Table 13 lists the most abundant fishes taken in this study. Six species made up almost 90 percent of the total catch, and addition of 7 more species brings that total to over 95 percent. The remaining 70 species made up less than 5 percent of the total catch. Of the 13 most abundant species, only 2 — the black crappie and the white catfish — were fresh-water species and they made up about 1.5 percent of the numbers taken. The remaining fishes were all marine, although all but one are capable of undergoing wide salinity changes — that is, are euryhaline. Therefore, they are largely characteristic of shallow shores and inshore waters. Furthermore, such fishes have a characteristically similar life history. They spawn in high or higher salinity waters and move back into lower salinity waters to grow up. Thus, most estuaries, such as the St. Lucie, are characterized biologically as nursery grounds. Total length data are not presented here, but it may be categorically stated that the majority of fishes caught were the young. Table 14 shows that almost precisely two-thirds of the hauls were made with the minnow seines next to shore. Furthermore, this table shows that the fishes taken in the seine hauls were about four times as numerous per haul as those taken in the trawl catches.

Table 15 indicates that the seine catch preponderance — which totaled almost seven times more than trawl catches — was caused by the catch of four species — mullet, menhaden, silversides, and anchovy. These were predominantly larval and juvenile fishes which reside in shallow waters and only the bay anchovy was taken in any numbers in the trawls. Further examination of the data (table 16) indicates that the vast preponderance of young shore fishes, chiefly mullet and menhaden, were caught in January, February and May 1958, when the spillway gates were open. In the midwinters of 1957 and 1959, the preponderance of seine-caught fishes over trawl catches was considerably less when the gates were closed. If the catch data from the 50-foot seine hauls were expanded to cover the entire 35-mile shoreline of the estuary, a rough approximation of the number of fish per mile of shoreline would have been 822,000 in January 1958, during the heavy discharges, as compared to 5,400 per mile in January 1957 after a long period of no lake discharge. Similar gross comparisons could be made for other periods during the 2 years of sampling.

Table 17 lists the less numerous fishes in arbitrary divisions of abundance. Table 18 gives the frequency at which various fishes were taken with different gear. This does not correspond except in a general way with total abundance. For instance, the sea catfish, sand perch, and whiff were taken in a considerable number of hauls but in relatively small numbers.

Table 12 lists the numbers of fishes taken in the three divisions of the estuary. In general, the South Fork was no saltier than the North Fork. However, the South Fork salinity varied with the opening of the gates and the North Fork salinity was often low from natural drainage.

This probably accounts for the larger number of marine fishes taken in the South Fork, although the numbers of species of both fresh and salt water fishes were much the same in both areas. The higher salinity of the outer estuary is reflected in the small number of fresh water fishes and the abundance of marine species. This information is summarized in table 19.

An inspection of table 16 reveals that the variations in numbers of the marine fishes is largely a reflection of the numbers of menhaden, mullet, anchovy, and tidewater silversides. The latter two were most abundant in the outer estuary. The menhaden was most abundant in the two inside forks and the little mullet was least abundant in the North Fork, being about equally present in the South Fork and outside estuary. The other most abundant fish, the croaker, did not vary much with opening or closing of the gates — that is, fresh water drainage. The common mojarra became less abundant.

Table 16 also indicates that 19 salt water species, including the most abundant ones, and 10 fresh water fishes were most abundant when the water was fresher. That increase included overwhelming numbers of mullet, menhaden and silversides. A few fishes — the pompano, puffers, mojarras, and few other saliniphilous species — became less abundant when the water was fresher. The commercial fishery catch (see Gunter, 1959) shows similarly that there was increase or decrease of certain species when the locks were open, but there was no decline of salt water commercial species as a whole.

In essence, the St. Lucie area is a habitat for estuarine or euryhaline fishes. When the salinity is lowered, many of them flourish in greater numbers than ever and a few high salinity forms leave the area. The region certainly does not become barren, it becomes more productive as indicated by the large crop of young fishes. The menhaden, mullet, and silversides are forage fishes and a greater production of these will lead to an increase of game fishes elsewhere, possibly in the outer estuary, at a later date. Mackerel and pompano and some other high salinity fishes leave when the salinity drops, but the statement that the gate openings result in barren waters and a dearth of small fishes is completely spurious. Summaries of these data are given in tables, 5, 6, 19, 20, 21, and 22. There is nothing in these observations contradictory to the idea that an opening or flow up to 3,500 cubic feet a second from St. Lucie Lock and Dam is beneficial to the general life of the estuary, and it is believed that a continuous flow of about 2,500 cubic feet a second would be an optimum. Much higher flows (up to 7,400 cubic feet a second) were not found to be damaging to estaurine life, and, in fact, the greatest production and survival of young fishes was found to occur in the spring of 1958 during the period of continued high fresh-water discharges from Lake Okeechobee (plate 16). The tons of nutrient material brought in with the fresh water are undoubtedly partly responsible for the higher production, since this same phenomenon has been observed and measured in other areas (Viosca, 1938; Gunter, 1953).

TABLE 12

Total number of each species of fish caught in the South Fork, North Fork, and outer estuary

Species	Number of fishes caught		
	South Fork	North Fork	Outer estuary
Stingaree (Dasyatis sabina)	4	2	1
Spotted gar (Lepisosteus platyrhincus)	-	1	-
Tenpounder (Elops saurus)	1	-	2
Menhaden (Brevoortia smithi)	1,388	1,386	974
Threadfin shad (Dorosoma petenense)	41	15	25
Gizzard shad (Dorosoma cepedianum)	-	-	4
Sardine (Harengula pensacolae)	-	-	55
Striped anchovy (Anchoa hepsetus)	-	-	22
Bay anchovy (Anchoa mitchilli)	465	177	824
Lizardfish (Synodus foetens)	1	-	15
Sea catfish (Galeichthys felis)	111	22	260
Gafftopsail catfish (Bagre marina)	6	-	-
Channel catfish (Ictalurus punctatus)	29	1	4
White catfish (Ictalurus catus)	124	22	17
Brown bullhead (Ictalurus nebulosus)	-	3	2
Golden shiner (Notemigonus crysoleucas)	-	-	1
Red minnow (Notropis maculatus)	11	-	4
Needlefishes (Strongylura spp.)	-	6	15
Redfin killifish (Lucania goodei)	4	1	-
Marsh killifish (Fundulus confluentus)	-	1	-
Seminole killifish (Fundulus seminolis)	-	2	-
Sheepshead killifish (Cyprinodon variegarus)	-	-	1
Flagfish (Jordanella floridae)	7	-	-
Mosquitofish (Gambusia affinis)	3	14	2
Least killifish (Heterandria formosa)	6	57	1
Seahorse (Hippocampus hudsonius)	-	-	1
Scovell's pipefish (Syngnathus scovelli)	-	-	16
Pipefishes (Syngnathus floridae)	1	-	7
(" louisianae)			
Redear sunfish (Lepomis microlophus)	1	-	-
Bluegill (Lepomis macrochirus)	14	2	22
Dollar sunfish (Lepomis marginatus)	1	-	1
Bluespotted sunfish (Enneacanthus gloriosus)	1	1	2
Black crappie (Pomoxis nigromaculatus)	-	184	1
Round pompano (Trachinotus falcatus)	27	-	116
Common pompano (Trachinotus carolinus)	-	-	15
Jacks (Caranx hippos)	14	-	16
(" latus)			
Bumper (Chloroscombrus chrysurus)	-		3
Moonfish (Vomer setapinnis)	-	-	1
Lookdown (Selene vomer)	-	1	5
Leatherjacket (Oligoplites saurus)	2	1	21
Snook (Centropomus undecimalis)	13	4	2
Mangrove snapper (Lutjanus griseus)	3	-	2
Spot snapper (Lutjanus synagris)	2	-	9
Pigfish (Orthopristis chrysopterus)	-	-	2
Sand perch (Diapterus olisthostomus)	33	17	48

TABLE 12

Total number of each species of fish caught in the South Fork, North Fork, and outer estuary

Species	Number of fishes caught		
	South Fork	North Fork	Outer estuary
Mojarra (Eucinostomus gula)	125	361	490
Yellow tail (Bairdiella chrysura)	76	9	12
Spotted weakfish (Cynoscion nebulosus)	-	1	-
White trout (Cynoscion regalis)	48	16	66
Spot (Leiostomus xanthurus)	22	23	138
King whiting (Menticirrhus americanus)	-	1	12
Croaker (Micropogon undulatus)	824	355	794
Black drum (Pogonias cromis)	6	1	17
Red drum (Sciaenops ocellata)	35	51	41
Star drum (Stellifer lanceolatus)	-	-	4
Sheepshead (Archosargus probatocephalus)	-	5	-
Pinfish (Lagodon rhomboides)	3	32	12
Spadefish (Chaetodipterus faber)	1	-	20
Sergeant major (Abudefduf saxatilis)	-	-	1
Cutlass fish (Trichiurus lepturus)	-	-	1
Mapo (Bathygobius soporator)	-	-	1
Darter goby (Gobionellus boleosoma)	8	3	40
Ocean goby (Gobionellus gracillimus)	1	1	8
Sharptail goby (Gobionellus hastatus)	-	1	6
Naked goby (Gobiosoma bosci)	1	-	-
Violet goby (Gobioides broussonneti)	1	1	4
Barracuda (Sphyraena barracuda)	-	-	1
Silver mullet (Mugil curema)	12	2	-
Striped mullet (Mugil cephalus)	5,570	1,774	5,047
Rough silverside (Membras martinica)	9	1	-
Tidewater silverside (Menidia beryllina)	486	179	1,041
Scorpionfish (Scorpaena grandicornis)	-	-	1
Sea robin (Prionotus tribulus)	1	-	3
Gulf whiff (Citharichthys macrops)	-	-	1
Spotfin whiff (Citharichthys spilopterus)	18	30	44
Fringed flounder (Etropus crossotus)	-	-	8
Sole (Achirus lineatus)	-	9	-
Hogchoker (Trinectes maculatus)	20	10	39
Tonguefish (Symphurus plagiusa)	6	4	11
Northern puffer (Sphoeroides maculatus)	-	-	2
Florida puffer (Sphoeroides nephelus)	-	-	1
Marbled puffer (Sphoeroides testudineus)	-	1	19
Spiny boxfish (Chilomycterus schoepfi)	-	-	3
Total:			
Fishes	9,586	4,790	10,407
Species	48	45	70
Number of samples	50	39	89
Average number of fishes per sample	191.7	122.8	126.8

NOTE: 1 dead eel (Anguilla rostrata) was caught in the November 1957 trawl catch in the South Fork and several dead tarpon (Megalops atlantica) were observed floating and caught in trawl hauls in all three reaches in February 1958.

TABLE 13

Total numbers of fishes caught and percentage of total catch for all species with more than 100 specimens — St. Lucie Estuary

Scientific name	Common name	Total no. catch	Percentage of total catch
Mugil cephalus	Striped mullet	12,391	50.0
Brevoortia smithi	Menhaden	3,748	15.1
Micropogon undulatus	Croaker	1,973	8.0
Menidia beryllina	Silversides	1,706	6.9
Anchoa mitchilli	Bay anchovy	1,466	5.9
Eucinostomus gula	Mojarra	976	3.9
	Subtotal	22,260	89.8
Galeichthys felis	Sea catfish	393	1.6
Pomoxis nigromaculatus	Black crappie	185	0.2
Leiostomus xanthurus	Spot	183	0.7
Ictalurus catus	White catfish	163	0.7
Trachinotus falcatus	Round pompano	143	0.6
Cynoscion regalis	White trout (weakfish)	130	0.5
Sciaenops ocellata	Red drum (redfish)	127	0.5
	Subtotal	23,584	95.2
	70 others	1,199	4.8
	Total	24,783	100.0

TABLE 14

Average catch per haul of fishes taken in trawls and seines in each collection in St. Lucie Estuary

Date	Number of hauls and average catch		
	Seines	Trawls	Total
Jan. 1957	14.	7.	21
	65.3	58.6	63.0
May 1957	12	7	19
	77.2	46.0	65.7
June 1957	16	5	21
	15.4	94.0	34.1
Sept. 1957	13	7	20
	47.6	47.6	47.6
Nov. 1957	8	7	15
	8.5	28.7	17.9
Total number of hauls, 1957	63	33	96
Average catch	44.0	52.6	47.0
Jan. 1958	8	7	15
	774.0	32.8	428.1
Feb. 1958	8	7	15
	893.1	64.1	506.3
May 1958	10	7	17
	372.1	80.8	252.2

TABLE 14

Average catch per haul of fishes taken in trawls and seines in each collection in St. Lucie Estuary

Date	Number of hauls and average catch		
	Seines	Trawls	Total
Oct. 1958	7	7	14
	46.7	33.6	40.1
Total number of hauls, 1958	33	28	61
Average catch	526.8	52.8	309.2
Jan. 1959	7	7	14
	184.8	16.3	100.6
Grand total number of hauls	103	68	171
Grand average catch	208.3	49.0	144.9

TABLE 15

Order of abundance of most numerous fishes taken in seines and trawls in St. Lucie Estuary

Seine catches		Trawl catches	
Species	Number of fishes caught	Species	Number of fishes caught
Striped mullet	12,387	Croaker	1,471
Menhaden	3,745	Sea catfish	381
Tidewater silversides	1,706	Bay anchovy	262
Bay anchovy	1,204	Black crappie	183
Mojarra	832	White catfish	161
Croaker	502	Mojarra	144
Spot	158	White trout	128
Round pompano	143	Yellowtail	97
Red drum	127	Spotfin whiff	81
Least killifish	64	Sand perch	78
Sardine	55	Hogchoker	69
Threadfin shad	47	Threadfin shad	34
Darter goby	46	Channel catfish	33
Pinfish	46	Spot	25
Total	21,062	Total	3,147

NOTE: The above catches of 23 species represent 97.5 percent of the total of all fishes collected.

TABLE 16

Total number of each species of fish in each collection from St. Lucie Estuary, January 1957 to January 1959 (lake-discharge condition indicated for each sampling period

Species of fish	Gates closed Jan. 28-29 1957	Gates closed May 16 1957	2,100 c.f.s. June 18 1957	6,680 c.f.s. Sept. 23 1957	Gates closed Nov. 13 1957(1)	7,380 c.f.s Jan. 27-28 1958	4,000 c.f.s. Feb. 24-25 1958	5,200 c.f.s. May 19-20 1958	Gates closed Oct. 27-28 1958(2)	Gates closed Jan. 27 1959	Total
Dasyatis sabina	1	1	—	2	1	—	—	3	—	—	8
Lepisosteus platyrhincus	—	—	—	—	—	—	—	1	—	—	1
Elops saurus	—	—	—	—	—	—	2	1	—	—	3
Brevoortia tyrannus	83	—	2	—	—	808	559	—	—	—	1,452
Brevoortia smithi	—	—	—	—	—	—	—	2,296	—	—	2,296
Dorosoma petenense	—	—	1	58	—	7	9	6	—	—	81
Dorosoma cepedianum	—	—	—	3	—	—	—	1	—	—	4
Harengula pensacolae	—	54	—	—	—	—	—	—	1	—	55
Anchoa hepsetus	—	—	—	9	1	—	—	6	1	7	24
Anchoa mitchilli	318	369	105	177	32	340	12	94	16	8	1,471
Synodus foetens	3	—	—	—	—	—	—	—	9	4	16
Galeichthys felis	7	35	14	41	36	116	92	29	19	4	393
Bagre marina	—	1	4	—	—	—	—	—	1	—	6
Ictalurus punctatus	—	—	4	16	—	7	1	6	—	—	34
Ictalurus catus	—	—	—	5	—	9	72	77	—	—	163
Ictalurus nebulosus	—	—	—	—	—	—	1	3	—	1	5
Notemigonus crysoleucas	—	—	—	—	—	1	—	—	—	—	1
Notropis maculatus	—	—	—	3	—	4	8	—	—	—	15
Strongylura spp.	—	2	—	2	—	—	—	10	6	1	21
Lucania goodei	—	1	—	—	—	—	—	—	—	4	5
Fundulus confluentus	—	1	—	—	—	—	—	—	—	—	1
Fundulus seminolis	—	—	—	—	—	1	—	—	—	1	2
Cyprinodon variegatus	—	—	—	—	—	1	—	—	—	—	1

TABLE 16

Total number of each species of fish in each collection from St. Lucie Estuary, January 1957 to January 1959 (lake-discharge condition indicated for each sampling period

Species of fish	Gates closed Jan. 28-29 1957	Gates closed May 16 1957	2,100 c.f.s. June 18 1957	6,680 c.f.s. Sept. 23 1957	Gates closed Nov. 13 1957(1)	7,380 c.f.s. Jan. 27-28 1958	4,000 c.f.s. Feb. 24-25 1958	5,200 c.f.s. May 19-20 1958	Gates closed Oct. 27-28 1958(2)	Gates closed Jan. 27 1959	Total
Jordanella floridae	—	—	—	—	—	1	—	4	—	2	7
Gambusia affinis	—	9	—	—	—	4	6	—	—	—	19
Heterandria formosa	—	57	3	2	—	2	—	—	—	—	64
Hippocampus hudsonius	1	—	—	—	—	—	—	—	—	—	1
Syngnathus scovelli	2	2	—	—	—	2	7	1	—	4	18
Syngnathus louisianae	1	—	—	—	1	—	—	—	1	3	6
Lepomis microlophus	—	—	—	—	—	1	—	—	—	—	1
Lepomis macrochirus	—	—	—	—	—	10	26	2	—	—	38
Lepomis marginatus	—	—	—	—	—	2	—	—	—	—	2
Enneacanthus gloriosus	—	—	—	—	—	3	—	—	1	—	4
Pomoxis nigromaculatus	—	—	—	—	—	1	184	—	—	—	186
Trachinotus falcatus	—	78	1	—	1	—	—	7	50	6	143
Trachinotus carolinus	—	14	—	—	—	—	1	—	—	—	15
Caranx spp.	—	3	11	—	2	—	1	9	4	—	30
Chloroscombrus chrysurus	—	—	—	—	—	—	—	—	2	1	3
Vomer setapinnis	1	—	—	—	—	—	—	—	—	—	1
Selene vomer	—	—	—	—	2	—	—	—	4	—	6
Oligoplites saurus	—	3	8	2	—	—	—	—	9	1	23
Centropomus undecimalis	—	1	3	5	6	—	—	1	2	1	19
Lutjanus griseus	—	—	3	2	—	1	1	—	—	—	7
Lutjanus synagris	—	—	—	—	—	—	—	—	9	—	9
Orthopristis chrysopterus	—	—	1	—	—	—	—	1	—	—	2
Diapterus olisthostomus	—	6	5	15	4	8	17	2	22	—	79

TABLE 16

Total number of each species of fish in each collection from St. Lucie Estuary, January 1957 to January 1959 (lake-discharge condition indicated for each sampling period

Species of fish	Gates closed Jan. 28-29 1957	Gates closed May 16 1957	2,100 c.f.s. June 18 1957	6,680 c.f.s. Sept. 23 1957	Gates closed Nov. 13 1957(1)	7,380 c.f.s. Jan. 27-28 1958	4,000 c.f.s. Feb. 24-25 1958	5,200 c.f.s. May 19-20 1958	Gates closed Oct. 27-28 1958(2)	Gates closed Jan. 27 1959	Total
Eucinostomus argenteus	21	159	36	66	25	18	5	—	30	200	560
Eucinostomus gula	19	4	—	8	9	—	—	—	238	165	443
Bairdiella chrysura	10	14	47	4	5	—	1	—	16	—	97
Cynoscion nebulosus	—	1	—	—	—	—	—	—	—	—	1
Cynoscion regalis	12	4	3	12	18	0	—	43	39	—	131
Leiostomus xanthurus	—	16	—	—	—	97	62	6	1	1	183
Menticirrhus americanus	1	4	—	1	3	—	—	2	2	—	13
Micropogon undulatus	195	211	303	153	83	25	190	360	21	424	1,965
Pogonias cromis	3	2	3	—	4	5	6	—	1	—	24
Sciaenops ocellata	118	—	—	—	—	2	2	—	3	2	127
Stellifer lanceolatus	—	—	—	—	—	—	3	1	—	—	4
Archosargus probatocephalus	—	—	—	—	3	2	—	—	—	—	5
Lagodon rhomboides	2	6	3	—	—	1	—	34	—	1	47
Chaetodipterus faber	—	—	—	1	—	—	1	—	18	1	21
Abudefduf saxatilis	1	—	—	—	—	—	—	—	—	—	1
Trichiurus lepturus	—	—	—	—	—	1	—	—	—	—	1
Bathygobius soporator	—	—	—	—	—	1	—	—	—	—	1
Gobionellus boleosoma	—	—	—	—	—	11	17	21	—	2	51
Gobionellus gracillimus	2	2	—	1	1	1	—	—	—	3	10
Gobionellus hastatus	—	—	—	—	—	2	—	5	—	—	7
Gobiosoma bosci	—	1	—	—	—	—	—	—	—	—	1
Gobioides broussonneti	—	—	1	—	—	2	1	2	—	—	6
Sphyraena barracuda	—	—	1	—	—	—	—	—	—	—	1

TABLE 16

Total number of each species of fish in each collection from St. Lucie Estuary, January 1957 to January 1959 (lake-discharge condition indicated for each sampling period

Species of fish	Gates closed Jan. 28-29 1957	Gates closed May 16 1957	2,100 c.f.s. June 18 1957	6,680 c.f.s. Sept. 23 1957	Gates closed Nov. 13 1957 (1)	7,380 c.f.s. Jan. 27-28 1958	4,000 c.f.s. Feb. 24-25 1958	5,200 c.f.s. May 19-20 1958	Gates closed Oct. 27-28 1958 (2)	Gates closed Jan. 27 1959	Total
Mugil curema	—	2	11	—	—	—	—	1	—	—	14
Mugil cephalus	481	156	75	—	2	4,618	6,056	464	9	530	12,391
Membras martinica	10	—	—	—	—	—	—	—	—	—	10
Menidia beryllina	—	—	63	356	16	275	234	730	21	11	1,706
Scorpaena grandicornis	—	1	—	—	—	—	—	—	—	—	1
Prionotus tribulus	2	—	—	—	—	—	—	—	—	2	4
Citharichthys macrops	—	1	—	—	—	—	—	—	—	—	1
Citharichthys spilopterus	16	14	3	2	2	6	—	41	1	7	92
Etropus crossotus	4	—	1	—	—	—	—	1	—	2	8
Achirus lineatus	—	—	—	1	8	—	—	—	—	—	9
Trinectes maculatus	1	3	2	4	2	24	12	14	4	3	69
Symphurus plagiusa	4	4	—	—	—	1	3	—	7	2	21
Sphoeroides maculatus	—	—	1	—	1	—	—	—	—	—	2
Sphoeroides nephelus	—	—	—	—	—	—	—	—	1	—	1
Sphoeroides testudineus	3	4	—	1	1	1	4	2	—	4	20
Chilomycterus schoepfi	2	1	—	—	—	—	—	—	—	—	3
Total	1,324	1,247	718	952	269	6,422	7,596	4,287	569	1,408	24,792
Species	(29)	(38)	(29)	(28)	(26)	(41)	(32)	(37)	(33)	(32)	—

NOTES: (1) Extremely poor seining conditions because of high winds and waves — no beaches. (2) Two seine stations (4 and 5) not sampled due to high tides of year.

In addition to the above, 1 dead eel (Anguilla rostrata) was caught in the January 1958 trawl collection and several dead tarpon (Megalops atlantica) were observed floating and caught in the trawl in February 1958.

TABLE 17

List of fishes caught in St. Lucie Estuary by all methods for all species with less than 100 specimens in the total catch

1 specimen

Florida spotted gar (Lepisosteus platyrhincus)
Golden shiner (Notemigonus crysoleucas)
Marsh killifish (Fundulus confluentus)
Sheepshead killifish (Cyprinodon variegatus)
Seahorse (Hippocampus hudsonius)
Redear sunfish (Lepomis microlophus)
Moonfish (Vomer setapinnis)
Spotted trout (Cynoscion nebulosus)
Sergeant major (Abudefduf saxatilis)
Cutlass fish (Trichiurus lepturus)
Mapo (Bathygobius soporator)
Naked goby (Gobiosoma bosci)
Barracuda (Sphyraena barracuda)
Scorpionfish (Scorpaena grandicornis)
Gulf whiff (Citharichthys macrops)
Florida puffer (Sphoeroides nephelus)

2 to 4 specimens

Tenpounder (Elops saurus)
Gizzard shad (Dorosoma cepedianum)
Seminole killifish (Fundulus seminolis)
Dollar sunfish (Lepomis marginatus)
Bluespotted sunfish (Enneacanthus gloriosus)
Bumper (Chloroscombrus chrysurus)
Pigfish (Orthopristis chrysopterus)
Star drum (stellifer lanceolatus)
Sea robin (Prionotus tribulus)
Northern puffer (Sphoeroides maculatus)
Spiny boxfish (Chilomycterus schoepfi)

5 to 10 specimens

Stingaree (Dasyatis sabina)
Brown bullhead (Ictalurus nebulosus)
Gafftopsail catfish (Bagre marina)
Redfin killifish (Lucania goodei)
Flagfish (Jordanella floridae)
Pipefishes (Syngnathus spp.-louisianae)
-floridae)
Lookdown (Selene vomer)
Mangrove snapper (Lutjanus griseus)
Sheepshead (Archosargus probatocephalus)
Ocean goby (Gobionellus gracillimus)
Sharptail goby (Gobionellus hastatus)
Violet goby (Gobioides broussonneti)
Rough silversides (Membras martinica)
Sole (Achirus lineatus)
Fringed flounder (Etropus crossotus)

11 to 25 specimens

Striped anchovy (Anchoa hepsetus)
Lizardfish (Synodus foetens)
Red minnow (Notropis maculatus)

TABLE 17

List of fishes caught in St. Lucie Estuary by all methods for all species with less than 100 specimens in the total catch

Needlefishes (Strongylura spp.-marina)
-notata)
Mosquitofish (Gambusia affinis)
Scovell's pipefish (Syngnathus scovelli)
Common pompano (Trachinotus carolinus)
Leatherjacket (Oligoplites saurus)
Snook (Centropomus undecimalis)
Spot snapper (Lutjanus synagris)
King whiting (Menticirrhus americanus)
Black drum (Pogonias cromis)
Spadefish (Chaetodipterus faber)
Silver mullet (Mugil curema)
Tonguefish (Symphurus plagiusa)
Marbled puffer (Sphoeroides testudineus)

26 to 50 specimens

Channel catfish (Ictalurus punctatus)
Bluegill (Lepomis macrochirus)
Jacks (Caranx spp.-latus)
-hippos)
Pinfish (Lagodon rhomboides)

50 to 100 specimens

Threadfin shad (Dorosoma petenense)
Sardine (Harengula pensacolae)
Least killifish (Heterandria formosa)
Sand perch (Diapterus olisthostomus)
Silver perch — yellowtail (Bairdiella chrysura)
Darter goby (Gobionellus boleosoma)
Spotfin whiff (Citharichthys spilopterus)
Hogchoker (Trinectes maculatus)

TABLE 18

Frequency of occurence of fishes in the trawl and seine collections for those species appearing in above 5 percent of the total station collections

Item	Trawls	Seines	All stations
Number of station collections	68	53	121
Species		Frequency (percent)	
Croaker (Micropogon undulatus)	81	17	53
Striped mullet (Mugil cephalus)	13	66	39
Bay anchovy (Anchoa mitchilli)	24	55	37
Mojarra (Eucinostomus gula)	18	55	34
Sea catfish (Galeichthys felis)	50	8	31
Tidewater silversides (Menidia beryllina)	0	66	29
Sand perch (Diapterus olisthostomus)	28	23	26
Spotfin whiff (Citharichthys spilopterus)	34	13	25

TABLE 18

Frequency of occurence of fishes in the trawl and seine collections for those species appearing in above 5 percent of the total station collections

Item	Trawls	Seines	All stations
Hogchoker (Trinectes maculatus)	41	0	23
Spot (Leiostomus xanthurus)	12	30	23
White trout (Cynoscion regalis)	35	2	21
Threadfin shad (Dorosoma petenense)	19	13	17
Snook (Centropomus undecimalis)	16	9	13
Menhaden (Brevoortia smithi)	4	30	13
Marbled puffer (Sphoeroides testudineus)	12	15	13
Darter goby (Gobionellus boleosoma)	7	17	12
White catfish (Ictalurus catus)	19	2	12
Yellowtail (Bairdiella chrysura)	19	0	11
Pipefishes (Syngnathus spp.)	0	25	11
Tonguefish (Symphurus plagiusa)	15	6	11
Bluegill (Lepomis macrochirus)	4	17	10
Red drum (Sciaenops ocellata)	0	23	10
Black drum (Pogonias cromis)	16	0	9
Pinfish (Lagodon rhomboides)	2	19	9
Jacks (Caranx spp.)	3	15	8
Channel catfish (Ictalurus punctatus)	13	2	8
Whiting (Menticirrhus americanus)	10	4	7
Round pompano (Trachinotus falcatus)	0	17	7
Needlefishes (Strongylura spp.)	0	17	7
Ocean goby (Gobiosoma gracillimus)	13	0	7
Leatherjacket (Oligoplites saurus)	0	15	7
Lizardfish (Synodus foetens)	2	11	6
Tenpounder (Elops saurus)	6	6	6
Mosquitofish (Gambusia affinis)	0	13	6
Red minnow (Notropis maculatus)	0	11	5
Striped anchovy (Anchoa hepsetus)	0	11	5
Stingaree (Dasyatis sabina)	7	2	5

TABLE 19

Salinity average of seine stations and bottom samples at trawl stations, together with numbers of species and numbers of individuals of marine and fresh-water fishes in each portion of the estuary

	South Fork	North Fork	Outer Estuary
Average salinity (p.p.t.)	6.0	6.3	14.1
Salinity range (p.p.t.)	0.14-20.5	0.14-20.2	0.15-36.0
Number of fresh-water species	12	13	13
Number of fresh-water fishes	242	304	86
Number of marine species	35	32	57
Number of marine fishes	9,344	4,486	10,321

TABLE 20

Summary of salinities (in p.p.t.) and numbers of fishes and invertebrate animals caught in St. Lucie Estuary

Item	1957					1958				1959
	Jan.	May	June	Sept.	Nov.	Jan.	Feb.	May	Oct.	Jan.
	28-29	16	18	23	13	27-28	24-25	19-20	27-28	27
Lake discharge (c.f.s.)	0	0	2,160	6,680	0	7,380	4,000	5,200	0	0
Salinity range (1)	14.0-36.0	3.7-32.4	0.5-22.8	0.16-22.8	5.2-31.3	0.14-4.5	<1.0-29.4	0.14-25.5	7.8-31.5	<1.0-33.8
Salinity average (1)	21.5	14.1	3.4	2.7	17.8	0.67	3.6	2.2	19.6	14.5
Number of hauls	21	19	21	20	15	15	15	17	14	14
Fishes										
Fresh-water species (2)	0	4	3	6	0	14	8	8	1	4
Marine species (2)	28	32	26	21	25	26	25	29	31	28
Fresh-water specimens	0	68	8	87	0	53	307	100	1	8
Marine specimens	1,324	1,180	709	865	269	6,369	7,287	4,187	561	1,400
Invertebrates										
Fresh-water species	1	1	2	2	1	1	1	2	0	1
Marine species	14	8	7	6	9	3	7	5	13	8
Fresh-water specimens	1	3	2	6	1	16	17	21	0	8
Marine specimens	188	361	119	17	60	24	54	233	640	96

NOTES: (1) Based on all seine station samples and bottom samples from trawl stations
(2) Based on spawning habitat.

TABLE 21

Salinity ranges per thousand at which the most abundant fishes in all collections were taken — St. Lucie Estuary

Item	Salinity range per thousand									
	0.5	0.5-1.9	2.0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0	Total
Species										
Mullet	(1) 10,732	679	262	224	45	68	1	380	—	12,391
Menhaden	(1) 3,578	62	25	—	31	7	45	—	—	3,748
Croaker	(1) 1,039	12	146	100	226	256	98	95	1	1,973
Silversides	(1) 1,412	207	40	10	20	2	10	5	—	1,706
Anchovy	(1) 543	119	13	301	94	101	287	8	—	1,466
Mojarra	80	7	315	82	74	41	12	(1) 361	4	976
Sea catfish	(1) 168	1	18	78	55	17	38	18	—	393
Black crappie	(1) 184	—	1	—	—	—	—	—	—	185
Spot	45	(1) 75	46	7	3	6	1	—	—	183
White cat	(1) 163	—	—	—	—	—	—	—	—	163
Round pompano	—	8	—	36	19	21	(1) 42	17	—	143
White trout	(1) 51	—	6	—	12	10	40	11	—	130
Red drum	2	1	3	—	(1) 49	36	16	20	—	127
Sand perch	(1) 33	8	7	22	7	—	15	6	—	98
Yellowtail	(1) 51	—	—	3	13	4	9	17	—	97
Whiff	(1) 44	2	2	—	4	9	16	15	—	92
Threadfin shad	(1) 75	3	2	1	—	—	—	—	—	81
Hogchoker	(1) 29	2	12	2	3	3	5	13	—	69
Total taken in salinity range	18,229	1,186	898	866	655	581	635	966	5	(2) 24,021
Percentage of total	75.9	4.9	3.7	3.6	2.7	2.4	2.6	4.0	0.1	100.0
No. of collections	50	3	6	10	13	11	13	10	5	121

NOTES: (1) Peak catch.
(2) 97 percent of all fish taken.

TABLE 22

Less abundant fishes taken in St. Lucie Estuary in certain salinity ranges (Salinity readings in parts per thousand)

Above 30.0 only

Hippocampus hudsonius (sea horse)
Scorpaena grandicornis (scorpionfish)
Citharichthys macrops (gulf whiff)

Above 25.0 only

Chilomycterus schoepfi (boxfish)
Vomer setapinnis (moonfish)
Sphoeroides nephelus (Florida puffer)
Abudefduf saxatilis (sergeant major)

Above 20.0 only

Chloroscombrus chrysurus (bumper)
Sphoeroides maculatus (N. puffer)
Orthopristis chrysopterus (pigfish)
Harengula pensacolae (sardine)
Etropus crossotus (fringed flounder)

Above 15.0 only

Selene vomer (lookdown)

Above 10.0 only

Synodus foetens (lizardfish)
Menticirrhus americanus (whiting)
Membras martinica (rough silversides)
Gobiosoma bosci (naked goby)
Chaetodipterus faber (spadefish)

Above 5.0 only

Prionotus tribulus (sea robin)
Syngnathus spp. (pipefishes)
Trachinotus carolinus (pompano)

Below 0.5 only

Dorosoma cepedianum (G. shad)
Notropis maculatus (red minnow)
Lepomis microlophus (redear sunfish)
Lepomis marginatus (dollar sunfish)
Cyprinodon variegatus (sheepshead killifish)
Jordanella floridae (flagfish)
Lepisosteus platyrhincus (spotted gar)

Below 2.0 only

Lepomis macrochirus (bluegill)
Notemigonus crysoleucas (golden shiner)
Ictalurus punctatus (channel cat)

Below 5.0 only

Lucania goodei (redfin killifish)
Fundulus confluentus (marsh killifish)
Gambusia affinis (mosquitofish)
Cynoscion nebulosus (spotted trout)
Sphyraena barracuda (barracuda)
Heterandria formosa (least killifish)
Bathygobius soporator (mapo)
Fundulus seminolis (Seminole killifish)
Trichiurus lepturus (cutlass fish)

Below 10.0 only

Ictalurus nebulosus (speckled bullhead)

TABLE 22

Less abundant fishes taken in St. Lucie Estuary in certain salinity ranges (Salinity readings in parts per thousand)

Elops saurus (tenpounder)
Enneacanthus gloriosus (bluespotted sunfish)
Mugil curema (silver mullet)
Scattered throughout range from 0.5 to 30.0
Syngnathus scovelli (Scovell's pipefish)
Sphoeroides testudineus (marbled puffer)
Pogonias cromis (black drum)
Gobionellus gracillimus (ocean goby)
Symphurus plagiusa (tonguefish)
Lagodon rhomboides (pinfish)
Strongylura spp. (needlefishes)
Bagre marina (gafftopsail catfish)
Caranx spp. (jacks)
Oligoplites saurus (leatherjacket)
Centropomus undecimalis (snook)
Lutjanus griseus (gray snapper)
Anchoa hepsetus (striped anchovy)
Lutjanus synagris (spot snapper)
Achirus lineatus (sole)
Archosargus probatocephalus (sheepshead)
Gobionellus boleosoma (darter goby)
Gobionellus hastatus (sharptail goby)
Gobioides broussonneti (violet goby)
Stellifer lanceolatus (star drum)
Dasyatis sabina (stingaree)

2.*Species account. Fishes.*

DASYATIDAE

Dasyatis sabina (LeSueur). Stingaree.

Eight specimens were caught in the trawls and the catch data are given in Table 23. It is well known that this ray enters fresh water and goes far upriver (Gunter, 1938) and it should be noted that five of the seven stingarees caught were taken in salinities of 0.2-0.3 parts per thousand, which is fresh water.

A dead specimen was taken at SS #2 on 24 February 1958. It was not measured. Presumably this specimen had been killed by previous hard cold waves.

Gunter (1945) thought the birth of stingarees takes place during an extended period over the warm part of the year in Texas waters. His smallest specimens, 13.0 cm in disk length, were taken in November. We also took a 13.0 cm specimen in November. We took two at still smaller sizes in September, which were probably born early that month or possibly in August. Numerous ichthyologists have seen stingarees give birth to young after being caught, but disk length data on newborn young seem to be lacking. Such data would be of some value even though the birth of captured stingarees might be premature.

TABLE 23

Catch records of *Dasyatis sabina*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#4	1	455	23.8	20.0
May 16, 1957	TS#1	1	305	26.0	10.0
Sept. 23, 1957	TS#2	2	118-120	28.1	0.17
Nov. 13, 1957	TS#2	1	130	22.1	14.8
May 19, 1958	TS#2	2	230	25.6	0.15
May 20, 1958	TS#6	1	170-350	25.6	0.34

LEPISOSTEIDAE

Lepisosteus platyrhincus DeKay. Florida spotted gar.

One gar, 51.8 cm in total length, was taken at SS #3 on 19 May in water with a temperature of 25.6°C and a salinity of 0.28 o/oo.

ELOPIDAE

Elops saurus Linnaeus. Tenpounder.

Two live fish were taken at SS #2 and TS #6 on 24 February 1960, and a third was caught at SS #5 on 19 May 1958. The lengths were 58.2, 28.5 and 35.5 cm and the temperatures and salinities, respectively, were 17.2, 16.1 and 24.4°C and 1.0, 7.0 and 0.15 parts per thousand. Two unmeasured dead fish were taken at TS #4 on 24 February 1958. Two dead fish, 46.9 and 30.6 cm long, were taken at TS #3 and TS #2 on 24 and 25 February 1958. Numerous tenpounders were also seen along the shoreline at this time. They were evidently killed by the cold and will be discussed further under cold kills.

MEGALOPIDAE

Megalops atlantica (Cuvier and Valenciennes). Tarpon.

No live specimens were taken. One dead tarpon, estimated to weigh about 60 pounds, was found floating at TS #3 on 24 February 1960. Another dead tarpon 75.0 cm long was taken at TS #5 and several unmeasured dead ones were seen along the shore at SS #3 on the same date. These fish were evidently killed by the previous cold.

CLUPEIDAE

Brevoortia tyrannus (Latrobe). Atlantic menhaden.

Data on the menhaden catches are given in Table 24. When the writers began this work, it was assumed that only *B. tyrannus* was present, and in fact neither *B. tyrannus* nor *B. smithi* had been reported in the literature so far south on the Atlantic. Since then Springer and Woodburn (1960) reported *B. tyrannus* young in the St. Lucie. The

table shows that only three menhaden were taken in trawls among the 3,748 fishes of both species caught. It seems clear that both species use the St. Lucie as a nursery ground and leave it quickly as they grow up. Otherwise greater numbers of menhaden would have been taken in the trawls.

In the southern part of its range *B. tyrannus* spawns in midwinter in contrast to a spring and summer spawning in the North Atlantic and New England states (see Gunter and Christmas, 1960, for literature). It should be noted in the table that no fish taken in January and February was longer than 33 mm total length. The size grouping is narrow, 20-33 mm, and frequency curves are not presented. These little menhaden all come from a winter spawning, and correspond in that respect to *B. patronus* on the Gulf Coast (Cf. Springer and Woodburn, *op. cit.*).

It should be noted that very few menhaden, 83, were taken in January 1957 when salinities were high and the St. Lucie Locks were closed, and similarly none were caught in January 1959. If small menhaden were present in these two years, they were farther back in the estuary than our stations extended.

TABLE 24

Catch records of *Brevoortia tyrannus* and *B. smithi*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
		Brevoortia tyrannus			
Jan. 29, 1957	SS#2	45 larvae	no lengths	24-1	20.1
Jan. 29, 1957	SS#3	31 "	22-28	24.9	14.0
Jan. 29, 1957	SS#4	4 "	27-33	24.3	17.0
Jan. 29, 1957	SS#5	3 "	26-28	24.0	19.3
June 18, 1957	TS#4	1	56	29.3	< 1.0
June 18, 1957	TS#5	1	60	28.8	1.2
Jan. 28, 1958	SS#5	5 larvae	23-27	17.4	0.35
Jan. 28, 1958	SS#1A	1 "	31	16.8	1.26
Jan. 28, 1958	SS#1A	47 "	20-25	16.8	1.26
Jan. 28, 1958	SS#6	750 "	25-30	—	0.32
Jan. 28, 1958	SS#2	5 "	24-27	—	0.34
Feb. 24, 1958	TS#1	1	62	14.4	< 1.0
Feb. 24, 1958	SS#1A	25	24-33	16.7	4.9
Feb. 24, 1958	SS#5	500	22-33	17.2	< 1.0
Feb. 24, 1958	SS#6	33	21-30	17.8	< 1.0
		Total 1452			
		Brevoortia smithi			
May 19, 1958	SS#2	20	16-38	26.1	0.19
May 19, 1958	SS#1A	13	41-62	25.6	1.04
May 19, 1958	SS#3	1354	28-61	25.6	0.28
May 19, 1958	SS#5	880	19-39	24.4	0.15
May 20, 1958	SS#6	29	24-41	25.6	0.30
		2296			
		Grand total 3748			

Brevoortia smithi Hildebrand. Atlantic fine-scale menhaden.

A few fish of this species may have been mixed with *B. tyrannus*, but by and large they were only taken in May 1958 when the lock gates were open and the salinities were low. This species spawns later than *B. tyrannus* and the occurrence of larvae in May corresponds with the findings of Springer and Woodburn concerning *B. smithi* on the Florida Gulf Coast. In May 1957 when the locks were closed and salinities were comparatively high, the young fish were rare or absent from the areas we fished and the large population of young fish was not encountered. The flow of fresh water into the St. Lucie obviously enhances its potentialities as a nursery ground for both *B. tyrannus* and *B. smithi*. The table shows that the young of both species were taken in abundance at salinities within the fresh-water range.

Dorosoma petenense (Günther). Threadfin shad.

This is a fresh water species which is commonly found in salt water along the Gulf Coast at larger sizes. Table 25 shows that only a few young and juveniles were taken in the St. Lucie at low salinities. Apparently, this fish leaves the estuary before it attains adult size. The smallest fish were taken in September and spawning probably takes place in late summer and early fall. This fish is also known to spawn in the spring and our data show two size groups in the early fall. Probably the fish spawns twice during the warm season, at least in south Florida.

TABLE 25

Catch records of *Dorosoma petenense*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	TS#5	1	69	28.8	1.2
Sept. 23, 1957	TS#3	1	55	23.1	0.17
Sept. 23, 1957	TS#4	12	41-62	22.9	0.18
Sept. 23, 1957	TS#5	3	79-90	23.8	0.20
Sept. 23, 1957	TS#6	1	84	23.4	0.34
Sept. 23, 1957	SS#4	25	23-28	28.1 surf	0.16
Sept. 23, 1957	SS#5	1	27	29.5 "	0.18
Sept. 23, 1957	SS#6	15	48-70	30.9 "	0.25
Jan 27, 1958	TS#1	4	46-48	15.5	0.18
Jan 27, 1958	TS#2	3	62-78	15.8	0.23
Feb. 24, 1958	TS#1	2	63-65	14.4	< 1.0
Feb. 24, 1958	TS#2	2	53-68	16.7	<< 1.0
Feb. 24, 1958	TS#4	1	79	14.4	< 1.0
Feb. 24, 1958	TS#6	1	50	16.1	7.0
Feb. 24, 1958	SS#1A	1	47	16.7 surf	4.9
Feb. 24, 1958	SS#5	2	52-53	17.2	< 1.0
May 19, 1958	TS#3	1	73	27.2	0.27
May 19, 1958	TS#5	1	78	25.6	0.15
May 20, 1958	SS#1A	2	40-72	25.6	1.04
May 19, 1958	SS#5	2	71-73	24.4	0.15
	Grand total 81				

Dorosoma cepedianum (LeSueur). Gizzard shad.

This is also a fresh water fish which occasionally enters waters of moderate to high salinity on the Gulf coast (Gunter, 1945). Four specimens were caught in the St. Lucie. Three fish, 64-80 mm long, were taken at TS #5 on 23 September 1957. The water temperature was 23.8°C and the salinity was 0.2. One fish, 27.0 cm long was caught at SS #2 on 19 May 1958. The temperature was 26.1°C and the salinity was 0.19 o/oo.

Harengula pensacolae (Goode and Bean). Sardine.

This fish is somewhat saliniphilous and apparently is only a stray in the outer estuary when salinities are high. Fifty-four *Harengula*. 27-34 mm long, were taken at SS #1A in the lower estuary on 16 May 1957 at a temperature of 28.0°C and a salinity of 21.5. One fish, 10.7 cm long, was taken at the same station on 27 October 1958 when the temperature was 25.6°C and the salinity was 27.4. Gunter (1945) found 33 mm fish in June in Texas. Springer and Woodburn report young in May in 1959, but the year before they appeared in June. The St. Lucie young seem to be earlier than those previously reported.

ENGRAULIDAE

Anchoa hepsetus (Linnaeus). Striped anchovy.

This anchovy is very abundant in nearshore and offshore shallow waters, but it is generally found in much higher salinities than *A. mitchilli*, the bay anchovy. It has a very large larva, up to about 35 mm total length. Table 26 shows that a high percentage of the 24 specimens caught in the St. Lucie were larvae. The remainder were juveniles. Gunter (1945) gave the top size in Texas waters as 141 mm. The largest fish taken in the St. Lucie was 67 mm long.

All anchovies of this species were taken in the lower estuary. The catch records are given in Table 26. One group of six fish was taken at a salinity of 1.0, which is the lowest salinity at which the species has been reported. The smallest fish were found in October and January. This puts a different light on the life history from the record presented by Gunter (1945) for Texas fishes, but it corresponds in part to what Springer and Woodburn found on the Florida Gulf coast, where the smallest specimens were taken in January.

Springer (1960) did not report this species from the St. Lucie.

TABLE 26

Catch records of *Anchoa hepsetus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Sept. 23, 1957	SS#1A	9	44-67	31.1	7.5
Nov. 13, 1957	SS#6	1	38	—	23.1
May 20, 1958	SS#1A	6	41-55	25.6	1.04
Oct. 27, 1958	SS#6	1	23	24.4	19.0
Jan. 27, 1959	SS#1A	7 larvae	25-30	21.1	25.9

TABLE 27
Catch records of *Anchoa mitchilli*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#1	4	38-61	24.1	17.0
Jan. 28, 1957	TS#2	5	44-66	23 3	20.5
Jan. 28, 1957	TS#3	1	57	23.3	14.8
Jan. 28, 1957	TS#4	2	46-48	23.8	20.0
Jan. 28, 1957	TS#5	131	34-66	24.5	21.0
Jan. 29, 1957	TS#6	2	47-55	23.7	29.2
Jan. 29, 1957	SS#3	7	36-48	24.9	14.0
Jan. 29, 1957	SS#3	70 larvae	26-37	24.9	14.0
Jan. 29, 1957	SS#4	48	25-48	24.3	17.0
Jan. 29, 1957	SS#5	48	39-58	24.0	19 3
May 16, 1957	TS#5	1	60	26.7	19.9
May 16, 1957	TS#6	1	40	26.7	22.9
May 16, 1957	SS#1A	120	27-64	28.0	21.5
May 16, 1957	SS#2	10	43-58	30.7	9.3
May 16, 1957	SS#3	1	47	28.3	3.7
May 16, 1957	SS#5	13	39-50	28.0	5.7
May 16, 1957	SS#4	223	31-54	28.0	9.5
June 18, 1957	SS#6	1	25	—	2.7
June 18, 1957	SS#2	17	42-49	30.0	0.8
June 18, 1957	TS#5	75	36-69	28.8	1.2
June 18, 1957	SS#5	12	35-39	—	< 1.0
Sept. 23, 1957	TS#3	1	40	23.1	0.17
Sept. 23, 1957	TS#4	18	39-55	22.9	0.18
Sept. 23, 1957	TS#5	4	47-60	23.8	0.20
Sept. 23, 1957	TS#6	9	46-56	23.4	0.34
Sept. 23, 1957	TS#7	1	36	—	23.5
Sept. 23, 1957	SS#1A	55	28-58	31.1	7.5
Sept. 23, 1957	SS#5	82 larvae	17-25	29.5	0.18
Sept. 23, 1957	SS#4	7	34-50	28.1	0.16
Nov. 13, 1957	SS#5	11	26-29	21.6	14.5
Nov. 13, 1957	SS#6	21	27-41	—	23.1
Jan. 27, 1958	SS#1A	38	22-47	16.8	1.26
Jan. 27, 1958	SS#6	302	28-30	—	0.32
Feb. 24, 1958	SS#1A	2	40-46	16.7	4.9
Feb. 24, 1958	SS#2	1	31	17.2	< 1.0
Feb. 24, 1958	SS#6	9	20-33	17.8	< 1.0
May 19, 1958	SS#2	4	25-44	26.1	0.19
May 19, 1958	SS#1A	4	20-65	25.6	1.04
May 19, 1958	SS#3	75	24-47	25.6	0.28
May 19, 1958	SS#5	6	30-50	24.4	0.15
May 19, 1958	SS#6	5	55-77	26.1	0.30
Oct. 27, 1958	TS#2	6	46-58	23.9	20.3
Oct. 27, 1958	TS#5	1	49	23.3	26.3
Oct. 27, 1958	TS#6	7	41-52	23.3	26.3
Oct. 27, 1958	SS#3	2	39-46	25.0	7.8
Jan. 27, 1959	SS#1A	2	48-55	21.1	25.9
Jan. 27, 1959	SS#1A	3	22-28	21.1	25.9
Jan. 27, 1959	SS#6	3	22-24	22.2	10.4
	Grand total	1471			

Anchoa mitchilli Cuvier. Bay anchovy.

Table 27 gives the catch records for this species. The larvae are easily overlooked. This little fish is ubiquitous in bays and estuaries and probably has the greatest species mass of any fish in estuarine waters of the south Atlantic and Gulf. Ripe fish and the smallest fish were taken in January and small fish were also taken in May and November. A long spawning season is indicated, as Gunter (1945) found in Texas waters. Small fish were found in both low and intermediate salinities. Gunter (*op. cit.*) noted that small fish were also found at high salinities and concluded that salinity was a minor factor in determining distribution of this anchovy. Present data reinforce this conclusion.

Springer and Woodburn say that their data are in contrast to Gunter (1945) and others "who noted that this species occurred primarily in open bays" (p. 21). Gunter (*op. cit.*) has shown that these little fish sometimes leave the shore. Springer and Woodburn's results may not be in contrast to previous findings at all and can be more logically explained on the grounds that these little fish sometimes leave shallow waters near shore, especially in winter, and in fact, the large populations may have been in the open bay at the time the inshore catches of Springer and Woodburn were low.

SYNODIDAE

Synodus foetens (Linnaeus). Lizard fish.

Table 28 shows that the lizard fish was only taken in the St. Lucie when salinities were comparatively high. The smallest fish were taken in January. Springer and Woodburn (1960) found their smallest specimens in November and December. Gunter (1945) found no lizard fish in bay and inshore Gulf waters during the winter in Texas. These data and those of Reid (1954) and Springer and Woodburn show that on the warmer Florida coasts lizard fish are to be found inshore in winter.

TABLE 28

Catch records of *Synodus foetens*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1959	TS#6	1	365	23.7	29.2
Jan. 29, 1959	SS#1	1	52	24.6	29.0
Jan. 29, 1959	SS#4	1	48	24.3	17.0
Oct. 27, 1958	SS#6	4	48-81	24.4	19.0
Oct. 27, 1958	SS#1A	5	54-81	25.6	27.4
Jan. 27, 1959	SS#1A	3	49-50	21.1	25.9
Jan. 27, 1959	SS#6	1	69	22.2	10.4
	Grand total	16			

ARIIDAE

Galeichthys felis (Linnaeus). Sea catfish.

The seacat was a common component of the trawl catches and at some stations it was the major part of the catch. It is well known that this species is euryhaline and it was found at all salinities. At salinities between 20 and 29.2 fifty-six fish were caught, with an average of 6.2 fish per haul where they were caught (not including stations where they were absent). At salinities of 10.0-19.9 seventy-two fish were caught with an average of 7.2 fish per haul where they were caught. At salinities of 0.15 to 9.9 two hundred and sixty-five catfish were caught with an average of 13.3 per haul where they were caught. It appears that the majority of the sea catfish in the St. Lucie preferred low salinity waters. Gunter (1945) found that in Texas waters not many fish were found at salinities below 5.0 *per mille*. Springer and Woodburn (1960) found, in contrast, that all but two of 736 specimens were taken at salinities close to 4.0 in the Tampa region. The present data confirm their findings relative to the distribution of *Galeichthys felis* in low salinity waters in Florida.

A brief analysis of the size of *G. felis* taken at different salinities shows that the fish taken in low salinities were somewhat smaller than fish at higher salinities. The data are as follows:

Salinity	Length range	Average	No. Specimens
0.2-0.7	43-340	152	166
1.0-9.9	77-308	137	99
10.0-19.9	125-440	208	72
20.0-29.2	43-345	170	56

The very smallest fish were taken in May and evidently they were hatched during that month. Ripe and spent females were also taken during that month. The breeding season in these waters seems to be at least a month earlier than reported for Texas waters (Gunter, 1945).

One fish measured 440 mm long, being the largest ever reported for this species.

Total length frequency curves were drawn for *G. felis* but they are not presented. The size ranges of the fish are shown in Table 29. The most abundant group in June 1957 was 141-150 mm in length. In September of that year the only mode was at 88 mm, undoubtedly made up of fish spawned early in the summer or late spring. There were slight signs of a second peak at 103 mm. In November 1957 the double peaks were more pronounced at 103 and 118 mm. In January 1958 the double peak showed at 118 and 133 mm. There was also a sharp mode of larger fish at 193 mm. A month later the two smaller peaks had more or less run together with a peak at 118-123 mm. The larger peak showed at 188 mm.

It would seem that in midwinter most young of the year are around 118 mm long and a second group approaching two years of age is around 185-190 mm long. Other size groups and year classes doubtless exist in the population at that time, but they were taken too few times to show distinctly in the length frequency curves. The large size of some of these fishes is shown by the length ranges in Table 29.

TABLE 29
Catch records of *Galeichthys felis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#1	5	128-151	24.1	17.0
Jan. 28, 1957	TS#5	1	345	24.5	21.0
Jan. 28, 1957	TS#6	1	74	23.7	29.2
May 16, 1957	TS#1	7	205-305	26.0	10.0
May 16, 1957	TS#1	6	140-168	26.0	10.0
May 16, 1957	TS#2	3	144-211	26.7	15.2
May 16, 1957	TS#3	1	258	26.5	5.4
May 16, 1957	TS#4	4	145-325	26.5	12.7
May 16, 1957	TS#5	7	125-150	26.7	19.9
May 16, 1957	TS#6	7	140-145	26.7	22.9
June 18, 1957	TS#2	1	285	28.7	0.7
June 18, 1957	TS#2	2	42-165	28.7	0.7
June 18, 1957	TS#6	10	145-267	28.3	22.8
June 18, 1957	TS#5	1	247	28.8	1.2
Sept. 23, 1957	TS#1	2	295-299	28.0	0.27
Sept. 23, 1957	TS#5	36	79-107	23.8	0.20
Sept. 23, 1957	TS#6	2	178-270	23.4	0.34
Sept. 23, 1957	TS#7	1	265	—	23.5
Nov. 13, 1957	TS#1	34	82-120	21.9	11.5
Nov. 13, 1957	TS#2	2	176-325	22.1	14.8
Jan. 27, 1958	TS#2	26	109-206	15.8	0.23
Jan. 28, 1958	TS#5	3	104-268	—	0.22
Jan. 28, 1958	TS#6	72	100-340	15.0	0.36
Jan. 27, 1958	TS#7	15	98-263	16.5	4.5
Feb. 25, 1958	TS#2	2	236-275	16.7	< 1.0
Feb. 24, 1958	TS#5	2	120-314	14.4	< 1.0
Feb. 24, 1958	TS#6	77	100-308	16.1	7.0
Feb. 24, 1958	TS#7	11	189-300	18.9	29.4
May 19, 1958	TS#3	7	123-245	27.2	0.27
May 19, 1958	TS#4	4	113-203	25.6	0.22
May 20, 1958	TS#7	6	43-195	24.4	25.5
May 19, 1958	SS#5	3	195-260	24.4	0.15
May 20, 1958	SS#6	7	135-292	26.1	0.30
May 20, 1958	SS#1A	1	230	25.6	1.04
May 19, 1958	SS#3	1	240	25.6	0.28
Oct. 27, 1958	TS#2	14	70-179	23.9	20.3
Oct. 27, 1958	TS#4	5	154-230	25.6	20.2
Jan. 27, 1959	TS#1	2	149-208	18.9	14.7
Jan. 27, 1959	TS#2	2	193-440	20.0	17.1
	Grand total	393			

Bagre marina (Mitchill). Gafftopsail catfish.

Catch records for the six specimens of gafftops are shown in Table 30. The smallest fish was taken in June. This catfish is evidently uncommon in the estuary.

TABLE 30

Catch records of *Bagre marina*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	TS#2	1	172	26.7	15.2
June 18, 1957	TS#2	4	91-110	28.7	0.7
Oct. 27, 1958	TS#2	1	190	23.9	20.3

ICTALURIDAE

Ictalurus punctatus (Rafinesque). Channel catfish.

Table 31 catch records show that this fresh water catfish came into the estuary sporadically when the salinities were low. Thirty-four specimens were caught. The highest salinity where the catfish was caught was 0.3, which is within the fresh water range.

Ictalurus catus (Linnaeus). White catfish.

The white catfish was more abundant in the estuary than the channel cat, but similarly it was restricted to fresh water. Seventy-seven fish were taken when there were high influxes of fresh water. Small newly hatched fish were taken in May. Catch records are given in Table 32.

Ictalurus nebulosus (LeSueur). Brown bullhead.

Only five specimens of this catfish were taken in the St. Lucie. Table 33 shows that it differed from the other two species of fresh water catfish in that it entered low salinity water, 6.3 parts per thousand.

TABLE 31

Catch records of *Ictalurus punctatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	TS#1	4	18-25	28.5	< 1.0
Sept. 23, 1957	TS#1	6	54-284	28.0	0.27
Sept. 23, 1957	TS#2	7	74-121	28.1	0.17
Sept. 23, 1957	TS#5	3	84-106	23.8	0.20
Jan. 27, 1958	TS#1	6	62-196	15.5	0.18
Jan. 27, 1958	TS#2	1	158	15.8	0.23
Feb. 24, 1958	TS#2	1	141	16.7	< 1.0
May 19, 1958	TS#1	2	165-170	24.4	0.14
May 19, 1958	TS#2	2	96-157	25.6	0.15
May 19, 1958	TS#4	1	124	25.6	0.22
May 19, 1958	SS#6	1	154	26.1	0.30

TABLE 32

Catch records of *Ictalurus catus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Sept. 23, 1957	TS#5	5	76-118	23.8	0.20
Jan. 27, 1958	TS#1	1	184	15.5	0.18
Jan. 27, 1958	TS#2	7	165-137	15.8	0.23
Jan. 27, 1958	TS#5	1	93	—	0.22
Feb. 24, 1958	TS#1	2	92-93	14.4	< 1.0
Feb. 24, 1958	TS#2	55	62-185	16.7	< 1.0
Feb. 24, 1958	TS#4	8	105-242	14.4	< 1.0
Feb. 24, 1958	TS#5	7	69-160	14.4	< 1.0
May 19, 1958	TS#1	12	16-31	25.6	0.14
May 19, 1958	TS#1	6	90-140	25.6	0.14
May 19, 1958	TS#2	1	16	25.6	0.15
May 19, 1958	TS#2	40	91-172	25.6	0.15
May 19, 1958	TS#3	5	124-263	25.6	0.27
May 19, 1958	TS#4	9	117-165	25.6	0.22
May 19, 1958	TS#5	2	97-188	25.6	0.15
May 19, 1958	SS#2	2	150-160	26.1	0.19

TABLE 33

Catch records of *Ictalurus nebulosus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Feb. 24, 1958	TS#5	1	156	14.4	< 1.0
May 19, 1958	TS#3	2	174-205	25.6	0.27
May 19, 1958	TS#4	1	205	25.6	0.22
Jan. 27, 1959	SS#2	1	105	22.8	6.3

CYPRINIDAE

Notemigonus crysoleucas (Mitchill). Golden shiner.

One fish 28 mm long was taken at SS #1A on 27 January 1958. The water temperature was 16.8°C and the salinity was 1.26 *per mille.*

Notropis maculatus (Hay). Red minnow.

Table 34 shows that fifteen specimens were taken at various seine stations in the estuary when the salinity was equivalent to fresh water. We are indebted to Dr. R. D. Suttkus for checking the identifications.

TABLE 34
Catch records of *Notropis maculatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Sept. 23, 1957	SS#4	3	30-34	28.1	0.16
Jan. 27, 1958	SS#4	4	33-42	—	0.25
Feb. 24, 1958	SS#2	2	39-44	17.2	< 1.0
Feb. 24, 1958	SS#4	5	30-56	14.4	< 1.0
Feb. 24, 1958	SS#6	1	42	17.8	< 1.0
	Grand total	15			

ANGUILLIDAE

Anguilla rostrata (LeSueur). American eel.

No live specimens were taken. A dead one was taken at TS #2 on 27 January 1958. This followed a cold spell and other dead fishes were taken at the same time. It was not measured.

BELONIDAE

Strongylura notata (Poey). Needlegar, and *Strongylura* sp.

The first four specimens listed in Table 35 were identified as *S. notata* at the Gulf Coast Research Laboratory. The others were listed as *Strongylura* sp. in the field. It is our impression that they were largely *notata* with some *S. marina*. The smallest needlegars were taken in May. Two *S. notata* were taken at 0.25 salinity, which is fresh water. This adds another belonid to the list of euryhaline fishes of North America (Gunter 1956).

TABLE 35
Catch records of *Strongylura notata* and *Strongylura sp.*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
		S. notata			
May 16, 1957	SS#1A	1	50	28.0	21.5
May 16, 1957	SS#3	1	93	28.3	3.7
Sept. 23, 1957	SS#6	2	106-247	30.9	0.25
		Strongylura sp.			
May 19, 1958	SS#2	1	36	26.1	0.19
May 20, 1958	SS#1A	1	76	25.6	1.04
May 19, 1958	SS#3	5	40-81	25.6	0.28
May 20, 1958	SS#6	3	62-74	26.1	
Oct. 27, 1958	SS#2	5	137-160	25.6	14.0
Oct. 27, 1958	SS#1A	1	470	25.6	27.4
Jan. 27, 1959	SS#1A	1	360	21.1	25.9
	Grand total	21			

CYPRINODONTIDAE

Lucania goodei Jordan. Red killifish.

One fish 23 mm long was taken at SS #3 on 16 may 1957 where the water temperature was 28.3°C and the salinity was 3.7. Four specimens were taken at SS #5 on 27 January 1959. Their length range was 17-29 mm. The water temperature was 20.0°C and the salinity was <1.0. Evidently this fresh water killifish ventures into low salinity waters at times.

Fundulus confluentus Goode and Bean. Marsh killifish.

One specimen was taken at SS #3 on 16 May 1957. It was 13 mm long. The water temperature was 28.3°C and the salinity was 3.7 o/oo.

Fundulus seminolis Girard. Seminole killifish.

One unmeasured specimen was taken at SS #3 on 27 January 1958 and another 21 mm long was taken at the same station precisely one year later. The respective temperatures were 17.7 and 20.6°C and the salinities were 0.26 and 2.4 o/oo. Evidently this fresh water killifish ventures at times into low salinity waters. We are indebted to Dr. R. R. Miller for checking the identification.

Cyprinodon variegatus Lacepede. Sheepshead minnow.

A single specimen, 25 mm long, was taken at SS #2 on 28 January 1958. The salinity was 0.34. The water temperature was not taken.

Jordanella floridae Goode and Bean. Flagfish.

One specimen was taken at SS #4 on 27 January 1958 and four were taken at the same station 19 May 1958. The first was unmeasured and no temperature was taken. The salinity was 0.25. The second group of four fish ranged from 19-23 mm in length. The temperature was 26.1°C and the salinity was 0.14. Two specimens were taken on 27 January 1959. They were 18 and 30 mm long; the water temperature was 25.6 and the salinity was <1.0. Apparently this little cyprinodontid only ventures into low salinity waters.

POECILIIDAE

Gambusia affinis (Baird and Girard). Mosquitofish.

Nineteen specimens were taken in seine hauls. The catch data are shown in table 36. The fish were all taken in fresh water except one group of nine taken at a salinity of 3.7. Gunter (1950) has noted that only one fish among 416 caught on the Aransas Refuge in Texas was taken in waters with a salinity as high as 3.1. This species was included on the list of euryhaline fishes of North America (Gunter, 1942) on evidence of Dr. S. F. Hildebrand, but it seems not to enter high salinity water very often, and possibly never when a choice is possible.

Heterandria formosa (Agassiz). Least killifish.

Sixty-four specimens were taken from low salinity water. In fact, all of them were in fresh water except at one station where 57 individuals were taken at a salinity of 3.7. Catch records are shown in table 37. Briggs (1958) lists this fish as euryhaline, but we believe that is an error for we know of no records of the fish in sea water. Our experience here and on the Florida Gulf coast indicates that the species is very similar to *Gambusia affinis* in its affinity for salt water, i.e., it is a fresh water species that ventures rarely into low salinity brackish waters.

TABLE 36

Catch records of *Gambusia affinis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#3	9	23-35	28.3	3.7
Jan. 27, 1958	SS#4	1	23	—	0.25
Jan. 27, 1958	SS#3	2	22-27	17.7	0.26
Jan. 27, 1958	SS#5	1	19	17.4	0.34
Feb. 24, 1958	SS#2	2	23-24	17.2	< 1.0
Feb. 24, 1958	SS#3	3	17-21	16.7	< 1.0
Feb. 24, 1958	SS#5	1	29	17.2	< 1.0

TABLE 37

Catch records of *Heterandria formosa*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#3	57	15-30	28.3	3.7
June 18, 1957	SS#4	3	19-25	29.0	< 1.0
Sept. 23, 1957	SS#4	2	22-23	28.1	0.16
Jan. 27, 1958	SS#4	1	29	—	0.25
Jan. 28, 1958	SS#6	1	20	—	0.32
	Grand total	64			

SYNGNATHIDAE

Hippocampus hudsonius DeKay. Seahorse.

One specimen, 182 mm long, was taken in the outer estuary on 29 January 1957 at TS #7. The bottom temperature and salinity were 22.2°C and 36.0 *per mille*.

Syngnathus scovelli (Evermann and Kendall). Pipefish.

This is the commonest pipefish of the shores of the South Atlantic and Gulf. The fish is euryhaline and is found over most of peninsular Florida. However, our records (table 38) show no specimens in lower salinities than 1.04. According to Springer and Woodburn the males mature at about 60 mm. They report that breeding goes on most of the year at Tampa. Our smallest fish were large juveniles (40-41mm long) and were taken in January and May. We took 18 *S. scovelli* in the samples.

Syngnathus louisianae (Günther). Longnose pipefish.

Table 39 shows that this pipefish was only taken in the cooler months of the year and generally at high salinities. Only six specimens were caught, ranging from 80 to 111 mm in length.

TABLE 38
Catch records of *Syngnathus scovelli*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#1	1	62	24.6	29.0
Jan. 29, 1957	SS#2	1	94	24.1	20.0
May 16, 1957	SS#1	1	40	28.0	15.5
May 16, 1957	SS#2	1	58	30.7	9.3
Jan. 27, 1958	SS#1A	2	67-82	16.8	1.26
Feb. 24, 1958	SS#1A	7	46-87	16.7	4.9
May 20, 1958	SS#1A	1	62	25.6	1.04
Jan. 29, 1959	SS#1A	4	41-78	21.1	25.9
	Grand total	18			

TABLE 39
Catch records of *Syngnathus louisianae*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#5	1	82	24.0	19.3
Nov. 13, 1957	SS#1A	1	80	21.6	29.8
Oct. 27, 1958	SS#1A	1	100	25.6	27.4
Jan. 27, 1959	SS#1A	1	107	21.1	25.9
Jan. 27, 1959	SS#2	2	110-111	22.8	6.3

CENTRARCHIDAE

Lepomis microlophus (Günther). Shellcracker.

On 27 January 1958 one specimen was taken at TS #1. It was 138 mm long. The bottom water temperature was 15.5°C and the salinity, 0.18, was in the fresh water range.

Lepomis macrochirus (Rafinesque). Bluegill.

Table 40 shows that the bluegill was caught in more hauls than any centrarchid taken in this study, but it was not the most abundant. Twenty-six specimens were taken in January, February and May 1958. The smallest fish, 34-35 mm long, were taken in January and February. The fish were all taken at salinities within the fresh water range, 0.15-0.38 o/oo, except for one specimen taken at a salinity of 1.04.

Lepomis marginatus (Holbrook). Dollar sunfish.

On 27 January 1958 one fish 37 mm long was taken at SS #5 where the temperature was 17.4°C and the salinity was 0.35 *per mille* The next day another specimen 26 mm long was taken at SS #2 where the salinity was 0.34. The temperature was not taken.

Enneacanthus gloriosus (Holbrook). Bluespotted sunfish.

Table 41 shows that three small fish were taken in January 1958 in very low salinity water, and that a still smaller fish, only 20 mm long, was taken in October at a salinity of 7.8, the maximum known for this species.

TABLE 40
Catch records of *Lepomis macrochirus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 27, 1958	SS#5	4	18-43	17.4	0.35
Jan. 28, 1958	SS#2	2	34-40	—	0.34
Jan. 27, 1958	TS#1	2	130-175	15.5	0.18
Jan. 27, 1958	TS#3	1	57	16.6	0.24
Jan. 27, 1958	TS#4	1	134	16.8	0.26
Feb. 24, 1958	SS#2	6	35-60	17.2	< 1.0
Feb. 24, 1958	SS#4	6	42-75	14.4	< 1.0
Feb. 25, 1958	SS#5	1	75	17.2	< 1.0
Feb. 24, 1958	SS#6	13	35-90	17.8	< 1.0
May 20, 1958	SS#1A	1	70	25.6	1.04
May 19, 1958	SS#5	1	51	24.4	0.15
	Grand total	38			

Pomoxis nigromaculatus (LeSueur). Speckled perch.

Table 42 shows that this species was taken on five occasions but one trawl haul contained 182 specimens. Probably the trawl was dragged through a school of fish. One fish was taken at a salinity of 4.1, which is the maximum reported for this species. The others were probably all in fresh water. The largest fish, 270 mm long, was taken dead on 24 February 1958 following a cold spell.

TABLE 41
Catch records for *Enneacanthus gloriosus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 27, 1958	SS#5	1	30	17.5	0.35
Jan. 28, 1958	SS#2	1	50	—	0.34
Jan. 28, 1958	TS#6	1	30	15.0	0.36
Oct. 27, 1958	SS#3	1	20	25.6	7.8

TABLE 42
Catch records for *Pomoxis nigromaculatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1958	TS#6	1	118	15.0	0.36
Feb. 24, 1958	TS#4	182	100-232	14.4	< 1.0
Feb. 24, 1958	TS#5	1	270	14.4	< 1.0
Feb. 24, 1958	SS#1A	1	135	16.7	4.9
Feb. 24, 1958	SS#2	1	102	17.2	< 1.0
	Grand total	186			

CARANGIDAE

Trachinotus falcatus (Linnaeus). Round pompano.

This pompano at small sizes was the most abundant carangid in the St. Lucie. One hundred and forty-three fish were taken. Table 43 shows that they were generally taken at moderate salinities. However, seven small fish were taken at a salinity of 1.04 and one was taken at 0.8, the lowest known salinity at which this pompano has been taken. Springer and Woodburn only found small *T. falcatus* at salinities above 33.3. Fish 16 to 17 mm long were taken in May and November and a long spawning season is indicated. The total lengths shown in table 43 might also be interpreted in terms of a spring and late summer spawning similar to what Springer and Woodburn believe takes place in the Tampa Bay area.

Small *T. falcatus* have a great deal of black on the body and some of them are almost totally black except for the orange fins. It is our impression that this black color is less noticeable on young from the outside beaches, which we have observed in other areas.

TABLE 43
Catch records of *Trachinotus falcatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#1A	42	19-40	28.0	21.5
May 16, 1957	SS#2	9	17-45	30.7	9.3
May 16, 1957	SS#5	27	25-46	28.0	5.7
June 18, 1957	SS#2	1	18	30.0	0.8
Nov. 13, 1957	SS#1A	1	16	21.6	29.8
May 20, 1958	SS#1A	7	18-32	25.6	1.04
Oct. 27, 1958	SS#2	13	32-89	25.6	14.0
Oct. 27, 1958	SS#6	21	20-34	24.4	19.0
Oct. 27, 1958	SS#1A	16	18-36	25.6	27.4
Jan. 27, 1958	SS#6	2	34-62	22.2	10.4
Jan. 27, 1958	SS#6	4	163-192	22.2	10.4
	Grand total	143			

TABLE 44
Catch records of *Trachinotus carolinus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#1A	13	22-36	28.0	21.5
May 16, 1957	SS#2	1	41	30.7	9.3
Feb. 24, 1958	TS#7	1	182	18.9	29.4
	Grand total	15			

Trachinotus carolinus (Linnaeus). Pompano.

Table 44 shows that mostly small fish were taken in the St. Lucie. The smallest fish were taken in May. In Texas waters Gunter (1945) found the smallest fish in June and Springer and Woodburn reported the same thing for the Tampa region. One fish was taken at a salinity of 9.3 which is the lowest of record for this pompano.

Caranx hippos (Linnaeus). Jack.

Fourteen specimens of small jacks were definitely identified as *Caranx hippos* and they are listed in table 45. This fish is euryhaline and it is not surprising to find the small fish in low salinity water.

Caranx latus (Agassiz). Hardtail jack.

Table 46 gives catch records on *C. latus*. It was taken in more hauls than *C. hippos* but was not more numerous.

Both *C. hippos* and *C. latus* enter fresh water. We have seen schools of jacks feeding at the surface in the North Fork and in the St. Lucie Locks when the waters were fresh, but the species could not be determined.

TABLE 45

Catch records of *Caranx hippos*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#5	3	25-37	38.0	5.7
June 18, 1957	SS#4	2	56-72	29.0	< 1.0
June 18, 1957	SS#5	9	39-90	—	< 1.0
	Grand total	14			

TABLE 46

Catch records of *Caranx latus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Nov. 13, 1957	TS#5	2	132-170	21.8	16.2
Feb. 24, 1958	TS#7	1	210	18.9	29.4
May 19, 1958	SS#2	1	24	26.1	0.19
May 20, 1958	SS#1A	5	22-29	25.6	1.04
May 20, 1958	SS#6	3	25-32	26.1	0.30
Oct. 27, 1958	SS#2	3	59-80	25.6	14.0
Oct. 27, 1958	SS#6	1	50	24.4	19.0
	Grand total	16			

Chloroscombrus chrysurus (Linnaeus). Bumper.

Three fish were taken at TS #6 on 28 October 1958 and 27 January 1959. The salinities were 26.3 and 24.0, respectively. The bottom temperature was 23.3°C at the first station and was unmeasured at the second. The two fish taken in 1958 were 62 and 64 mm long; the 1959 specimen was 91 mm long.

Vomer setapinnis (Mitchill). Moonfish.

One fish 131 mm long was taken on 29 January 1957 at TS #6 The temperature of the bottom water was 23.7°C and the salinity was 29.2.

Selene vomer (Linnaeus). Lookdown.

Table 47 shows that six fish, ranging from 44 to 117 mm in length were taken in the fall of 1957 and 1958. The salinity of 16.2 in November 1957 is considerably lower than any previously reported for this species.

TABLE 47

Catch records of *Selene vomer*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Nov. 13, 1957	TS#5	1	150	21.8	16.2
Nov. 13, 1957	SS#1A	1	92	21.6	29.8
Oct. 27, 1958	TS#4	1	44	25.6	20.2
Oct. 27, 1958	TS#5	3	67-117	23.3	26.3
	Grand total	6			

TABLE 48

Catch records of *Oligoplites saurus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#2	2	32-33	30.7	9.3
May 16, 1957	SS#5	1	50	28.0	5.7
June 18, 1957	SS#4	1	43	29.0	< 1.0
June 18, 1957	SS#6	7	40-92	—	2.7
Sept. 23, 1957	SS#6	2	92-120	30.9	0.25
Oct. 27, 1958	SS#2	8	67-98	25.6	14.0
Oct. 27, 1958	SS#6	1	42	24.4	19.0
Jan. 27, 1959	SS#2	1	82	22.8	6.3
	Grand total	23			

Oligoplites saurus (Bloch and Schneider). Leatherjacket.

Table 48 shows that twenty-three fish were caught in the seines. Schools of leatherjackets were often seen near shore but the fish generally eluded the seine. The smallest fish were taken in mid-May and they were probably spawned in late April. We took two fish at a salinity of 0.25, in the fresh water range, and this record adds another species to the euryhaline fishes of North America.

CENTROPOMIDAE

Centropomus undecimalis (Bloch). Snook.

Table 49 gives the catch record on the snook. It was the commonest

large fish taken in the trawls, with the exception of *Diapterus*. The snook is euryhaline and the table shows that it pays little attention to salinity of the water. In fact, most fish were taken in fresh water. This fish is one of those caught in greatest abundance by pole and line fishermen at the St. Lucie Locks when the gates are open and large quantities of Lake Okeechobee water are flowing through. No small snook were taken and we have little to add to the life history except to say that this species seemed to be least abundant in the St. Lucie Estuary during the colder months. The species belongs to a tropical family and is evidently sensitive to cold. Many dead snook were seen on 24 February 1958 following the coldest weather of record for Stuart, Florida.

TABLE 49

Catch records of *Centropomus undecimalis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#3	1	48	28.3	3.7
June 18, 1957	TS#1	1	304	28.5	< 1.0
June 18, 1957	SS#4	1	103	29.0	< 1.0
June 18, 1957	SS#2	1	115	30.0	0.8
Sept. 23, 1957	TS#1	1	550	28.0	0.27
Sept. 23, 1957	TS#2	1	398	28.1	0.17
Sept. 23, 1957	TS#3	2	45-344	23.1	0.17
Sept. 23, 1957	SS#4	1	128	28.1	0.16
Nov. 13, 1957	TS#1	6	270-405	21.9	11.5
Feb. 24, 1958	TS#2	1	420 (dead)	16.7	< 1.0
Feb. 24, 1958	SS#3	numerous dead snook observed along shoreline & floating in water		17.2	< 1.0
Feb. 24, 1958	SS#3	(cold kill)			
Feb. 24, 1958	TS#5	1	321 (dead)	14.4	< 1.0
May 19, 1958	SS#2	1	235	26.1	0.19
Oct. 27, 1958	TS#1	1	375	23.9	7.8
Oct. 27, 1958	TS#4	1	468	25.6	20.2
Jan. 27, 1959	TS#1	1	380	18.9	14.7
	Grand total	21			

LUTJANIDAE

Lutjanus griseus (Linnaeus). Mangrove snapper.

Table 50 shows that this snapper was taken six times in fresh, or nearly fresh water and only once at a high salinity.

Lutjanus synagris (Linnaeus). Lane snapper.

Eight specimens, 29-57 mm long, were taken on 27 October 1958 at SS #1A. The water temperature was 25.6°C and the salinity was 27.4. A 73 mm fish was taken on the same date at TS #6, where the temperature was 23.3°C and the salinity was 26.3. Springer and Woodburn took this species in the Tampa area only from October to December and found the smallest specimens in November.

TABLE 50
Catch records of *Lutjanus griseus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	SS#5	3	122-144	—	< 1.0
Sept. 23, 1957	SS#5	2	75-117	29.5	0.17
Jan. 28, 1958	TS#6	1	118	15.0	0.36
Feb. 24, 1958	TS#7	1	238	18.9	29.4
	Grand total	7			

POMADASYIDAE

Orthopristes chrysopterus (Linnaeus). Pigfish.

This is a rather handsome fish which takes its name from the noise it makes when caught. On 18 June 1957 one fish 202 mm in length was taken at TS #6 at a water temperature of 28.3 and a salinity of 22.8. A fish 217 mm long was taken at TS #7 on 20 May 1958. The bottom temperature was 24.4 and the salinity was 25.5 o/oo.

GERRIDAE

Diapterus olisthostomus (Goode and Bean). Sand perch.

Several large specimens were taken in the trawls and sometimes in seines, and table 51 shows that it was taken in greater numbers than any other large fish. The salinities were generally quite low and this mojarra was taken several times in fresh water. Briggs (1958) has previously listed the fish as euryhaline. The smallest fish were taken in May. Several *Diapterus* were killed by cold waves in February 1958.

Eucinostomus argenteus (Baird and Girard). Mojarra.

Most mojarras were identified in the field and undoubtedly there was some confusion between this species and the succeeding species, *E. gula*. It is our impression that *E. argenteus* was most abundant in the St. Lucie Estuary and that *E. gula* was less numerous during the time of our work.

Table 52 shows that 565 fish were listed as *E. argenteus*. Many of them were taken at very low salinities. The species should be included among the euryhaline fishes. Fish over 100 mm long were taken in the months of May 1957, and January 1958 and 1959. Fish 20 mm long or a little less were taken in May, September, and November 1957 and January 1959. This presents a seeming anomalous situation for marine organisms do not ordinarily breed in both the warm and cold periods of the year according to Orton's rule (see Gunter, 1958 for discussion). However, Springer and Woodburn (1960) found a somewhat similar situation with regard to *E. argenteus* in the Tampa region. Their smallest fish were taken in October, November and June, and fish of a size equivalent to our smaller ones were taken in November and December. At least it can be concluded that *E. argenteus* has a long spawning season.

Ladyfish and sand perch killed by the cold in North Fork, St. Lucie Estuary, February 1958.

Dead tarpon found floating in North Fork St. Lucie Estuary after cold kill, February 1958.

Sample of live fish (croaker, spot, sand perch, pig fish, puffers, gobies) and crabs collected with trawl at TS7, St. Lucie Estuary, during February 1958 when large numbers of tropical forms were killed throughout the estuary by low temperatures.

TABLE 51

Catch records of *Diapterus olisthostomus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	TS#4	2	30-71	26.5	12.7
May 16, 1957	SS#5	4	34-44	28.0	5.7
June 18, 1957	SS#4	1	48	29.0	< 1.0
June 18, 1957	TS#4	2	44-51	29.8	29.3
June 18, 1957	SS#5	2	107-115	—	< 1.0
Sept. 23, 1957	TS#2	1	340	28.1	0.17
Sept. 23, 1957	TS#3	2	118-200	23.1	0.17
Sept. 23, 1957	TS#4	2	98-116	22.9	0.18
Sept. 23, 1957	TS#5	4	65-95	23.8	0.20
Sept. 23, 1957	TS#6	5	92-103	23.4	2.34
Sept. 23, 1957	TS#7	1	93	28.1	0.16
Nov. 13, 1957	TS#1	3	69-103	21.9	11.5
Nov. 13, 1957	TS#2	1	98	22.1	14.8
Jan. 27, 1958	SS#1A	1	99	16.8	1.26
Jan. 27, 1958	TS#2	7	109-201	15.8	0.23
Feb. 24, 1958	TS#3	9	205-309 (dead)	18.9	< 1.0
Feb. 24, 1958	TS#6	14	120-258	16.1	7.0
Feb. 24, 1958	TS#6	1	360 (dead)	16.1	7.0
Feb. 24, 1958	TS#7	1	266	18.9	29.4
Feb. 24, 1958	SS#6	2	211-338	17.8	< 1.0
May 19, 1958	TS#3	1	280	25.6	0.27
May 19, 1958	SS#1A	1	198	25.6	1.04
Oct. 27, 1958	TS#1	2	126-140	23.9	7.8
Oct. 27, 1958	TS#2	10	66-85	23.9	20.3
Oct. 27, 1958	TS#4	4	43-84	25.6	20.2
Oct. 27, 1958	TS#5	3	65-77	23.3	26.3
Oct. 27, 1958	TS#6	2	79-83	23.3	26.3
Oct. 27, 1958	SS#2	1	78	25.6	14.0
	Grand total	87			

TABLE 52

Catch records of fish identified as *Eucinostomus argenteus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#3	8	39-79	24.9	14.0
Jan. 29, 1957	SS#4	9	31-68	24.3	17.0
Jan. 29, 1957	SS#5	4	32-45	24.0	19.3
May 16, 1957	TS#3	1	25	26.5	5.4
May 16, 1957	SS#3	113	18-74	28.3	3.7
May 16, 1957	SS#5	37	26-110	28.0	5.7
May 16, 1957	SS#4	8	19-55	28.0	9.5
June 18, 1957	SS#4	12	52-70	29.0	< 1.0
June 18, 1957	SS#6	15	45-74	—	2.7
June 18, 1957	SS#2	1	70	30.0	0.8

TABLE 52

Catch records of fish identified as *Eucinostomus argenteus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	SS#5	8	49-68	—	< 1.0
Sept. 23, 1957	TS#3	3	38-53	23.1	0.17
Sept. 23, 1957	TS#4	4	33-68	22.9	0.18
Sept. 23, 1957	TS#6	1	40	23.4	0.34
Sept. 23, 1957	SS#1A	5	22-40	31.1	7.5
Sept. 23, 1957	SS#3	4	39-70	28.6	0.17
Sept. 23, 1957	SS#4	43	20-56	28.1	0.16
Sept. 23, 1957	SS#5	6	46-84	29.5	0.17
Nov. 13, 1957	TS#3	4	32-55	22.1	10.1
Nov. 13, 1957	TS#4	18	27-75	22.1	12.7
Nov. 13, 1957	TS#5	3	20-67	21.8	16.2
Jan. 27, 1958	SS#1A	12	40-97	16.8	1.3
Jan. 27, 1958	TS#6	6	84-132	15.0	0.36
Feb. 24, 1958	SS#1A	5	44-85	16.7	4.9
Oct. 27, 1958	TS#1	2	67-79	23.9	7.8
Oct. 27, 1958	TS#2	1	29	23.9	20.3
Oct. 27, 1958	TS#4	3	29-39	25.6	20.2
Oct. 27, 1958	SS#3	24	29-53	25.0	7.8
Jan. 27, 1959	SS#2	13	26-113	22.8	6.3
Jan. 27, 1959	SS#3	183	17-33	20.6	2.4
Jan. 27, 1959	SS#4	2	20-23	20.0	< 1.0
Jan. 27, 1959	SS#5	2	26-28	20.0	< 1.0
	Grand total	560			

TABLE 53

Catch records of fishes listed as *Eucinostomus gula*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	TS#6	1	38	23.7	29.2
Jan. 29, 1957	SS#1	18	30-47	24.6	29.0
May 16, 1957	SS#1	3	61-78	28.0	15.5
May 16, 1957	SS#1A	1	85	28.0	21.5
Sept. 23, 1957	TS#7	8	53-87	—	23.5
Nov. 13, 1957	SS#1A	9	13-81	21.6	29.8
Oct. 27, 1958	TS#5	2	72-76	23.3	26.3
Oct. 27, 1958	TS#6	58	45-97	23.3	26.3
Oct. 27, 1958	TS#7	4	58-98	25.6	31.5
Oct. 27, 1958	SS#2	23	64-101	25.6	14.0
Oct. 27, 1958	SS#6	22	13-68	24.4	19.0
Oct. 27, 1958	SS#1	129	36-91	27.4	27.4
Jan. 27, 1959	SS#1	144	27-94	21.1	25.9
Jan. 27, 1959	SS#6	21	43-91	22.2	10.4
	Grand total	443			

Eucinostomus gula (Cuvier and Valenciennes). Mojarra.

Four hundred and forty-three fish of this species were listed and the catch records are given in table 53. They apparently became more common in late 1958 and 1959 when the St. Lucie Lock gates were closed and the salinities rose. The very smallest fish were taken in October and November which corresponds to what Springer and Woodburn found for *E. argenteus* at Tampa. Possibly, the species were confused. In any case, it is clear that *E. gula* is generally found at higher salinities than *E. argenteus*, as Springer and Woodburn also found.

SCIAENIDAE

Bairdiella chrysura (Lacépède). Yellowtail.

Ninety-seven fish were taken, as shown in table 54, generally in waters of moderate and high salinities. However, four fish were taken in fresh water in November 1957 and the species belongs on the list of euryhaline fishes. The smallest fish were taken in May, as Springer and Woodburn found in the Tampa region and, presumably, spawning took place in April. The collections were not extensive enough to yield further information. We took one fish 212 mm in total length which seems to be the largest reported for the South Atlantic and Gulf.

TABLE 54
Catch records of *Bairdiella chrysura*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#5	9	126-174	24.5	21.0
Jan. 28, 1957	TS#6	1	184	23.7	29.2
May 16, 1957	TS#1	1	155	26.0	10.0
May 16, 1957	TS#2	4	62-68	26.7	15.2
May 16, 1957	TS#3	2	30-34	26.5	5.4
May 16, 1957	TS#4	7	32-51	26.5	12.7
June 18, 1957	TS#2	47	61-84	28.7	0.7
Sept. 23, 1957	TS#2	3	98-104	28.1	0.17
Sept. 23, 1957	TS#5	1	108	23.8	0.20
Nov. 13, 1957	TS#1	3	99-109	21.9	11.5
Nov. 13, 1957	TS#2	2	88-97	22.1	14.8
Feb. 24, 1958	TS#6	1	140	16.1	7.0
Oct. 27, 1958	TS#2	16	55-212	23.9	20.3
	Grand total	97			

Leiostomus xanthurus (Lacépède). Spot.

One hundred and eighty-three spots were taken. Ninety-seven of them were small fish 16-34 mm in total length taken in very low salinity waters within the fresh water range in January 1958. Thirty-two more fish 25-46 mm long were taken a month later in waters with salinities less than 1.0. The larger fish were generally taken in saltier waters.

Larger spots in the St. Lucie were taken somewhat sporadically. As the smaller fish grow, they move out to saltier water which causes them, as with many other estuarine species, to have a generally direct relation between salinity and size.

Springer and Woodburn also showed that small spots appeared in Tampa Bay in January; this is earlier than Günter (1945) found them in Texas waters but corresponds to Pearson's (1929) findings for the same region. The young Tampa Bay spots were in salinity of 5.0 *per mille*, somewhat higher than found in the St. Lucie. This is not surprising for, as was stated above, the relation of size to salinity is not absolute. Young spots will probably grow in waters with a considerably higher salinity than 5.0, especially if no lower salinity area is available.

Catch records are given in table 55.

TABLE 55

Catch records of *Leiostomus xanthurus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	TS#2	4	90-112	26.7	15.2
May 16, 1957	TS#4	3	89-113	26.5	12.7
May 16, 1957	TS#5	1	114	26.7	19.9
May 16, 1957	SS#3	4	63-73	28.3	3.7
May 16, 1957	SS#4	4	96-117	28.0	9.5
Jan. 27, 1958	SS#4	2	—	—	0.25
Jan. 27, 1958	SS#3	7	21-31	17.7	0.26
Jan. 27, 1958	SS#5	4	26-34	17.4	0.35
Jan. 27, 1958	SS#1A	74	20-34	16.8	1.26
Jan. 27, 1958	SS#2	4	27-33	—	0.34
Jan. 27, 1958	SS#6	5	16-34	—	0.32
Jan. 27, 1958	TS#2	1	28	15.8	0.23
Feb. 24, 1958	TS#5	4	25-33	14.4	< 1.0
Feb. 24, 1958	TS#6	3	199-209	16.1	7.0
Feb. 24, 1958	SS#1A	27	27-44	16.7	4.9
Feb. 24, 1958	SS#2	15	30-46	17.2	< 1.0
Feb. 24, 1958	SS#3	1	31	16.7	< 1.0
Feb. 24, 1958	SS#5	2	25-33	17.2	< 1.0
Feb. 24, 1958	SS#6	3	33-37	17.8	< 1.0
Feb. 24, 1958	TS#2	3	34-38	16.7	< 1.0
Feb. 24, 1958	ST#4	4	30-35	14.4	< 1.0
May 19, 1958	SS#2	1	89	26.1	0.19
May 20, 1958	SS#1A	1	41	25.6	1.04
May 19, 1958	SS#3	4	85-96	25.6	0.28
Oct. 27, 1958	TS#2	1	143	23.9	20.3
Jan. 27, 1959	TS#2	1	245	20.0	17.1
	Grand total	183			

Menticirrhus americanus (Linnaeus). Whiting.

The literature indicates that this fish has a long spawning season

over the warmer months. Table 56 shows that the smallest fish we caught were taken in November. This fish was not abundant and only a dozen were caught. It does not venture into low salinity waters. The lower salinity limits given by Gunter (1945), Reid (1954), and by Springer and Woodburn (1960) are 14.4, 17.5, and 13.7. We found 12.7 as the lower limit in the St. Lucie.

TABLE 56
Catch records of *Menticirrhus americanus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#5	1	149	24.5	21.0
May 16, 1957	TS#4	1	216	26.5	12.7
May 16, 1957	TS#5	1	203	26.7	19.9
May 16, 1957	TS#6	2	42-245	26.7	22.9
Sept. 23, 1957	TS#7	1	97	—	23.0
Nov. 13, 1957	TS#7	3	23-34	—	23.1
May 20, 1958	TS#7	2	69-99	24.4	25.5
Oct. 28, 1958	TS#6	1	68	23.3	26.3
Oct. 28, 1958	SS#1A	1	43	25.6	27.4
	Grand total	13			

Micropogon undulatus (Linnaeus). Croaker.

The catch records are given in table 57. It is clear that a number of specimens were taken in quite low salinity water. However, there was no large effect to be noted when the lock gates were opened or closed and the salinity varied. It is well known that this species is euryhaline.

Contributions to the life history of the croaker on the Gulf coast have been presented by Pearson (1929), Gunter (1945), Suttkus (1955) and Springer and Woodburn (1960). In the northern Gulf croakers spawn in outside waters from October to January and the larvae come into the bays from January to March. Springer and Woodburn found croakers 16 to 25 mm in standard length in Tampa Bay only in April, which indicates a slightly different spawning season in south Florida.

However our data from the St. Lucie are somewhat different. In the first place, small croakers were taken in the months of November, January and February and this appears to be quite similar to the fall and winter spawning and influx of the young known for the northern and western Gulf. The most interesting fact was the taking of small croakers in June 1957. We took 19 fish measuring 22 to 28 mm in total length. Insofar as we measured to the tip of the attenuate tail these fish were quite small, 16-17 mm in standard length. They were taken after the winter and spring influx of young had ceased. There is certainly a second spawning coming at the beginning of summer. This means that the croaker spawns on rising as well as falling temperatures and thus violates Orton's rule (see above).

Gunter and Shell (1958) also found a small influx of very small croakers into White Lake, Louisiana, in mid-summer. However, as was explained in that paper, the raw data were lost during a cross-country move of the senior author and since total lengths were not available, the fact was not mentioned. In any case, there seems to be no doubt that in widely scattered areas and years there is sometimes a late spring and summer spawning of the croaker, quite distinct from the fall and winter spawning. This complicates life history interpretations of size and growth data. This seems to be a more plausible explanation of some of the anomalies noted by Springer and Woodburn (p. 61) than different growth rates and "stunting" which they seem to favor. Small fish that fail to get enough food fail to grow, but they also die and stunting is an improbable explanation of different size groups of fishes in the rich waters of the shallow Gulf.

Length frequency curves were drawn for seven months of the work, but they are not presented and instead the general features are given in table 58.

Gunter (1945) reported the largest croaker taken among 15,857 specimens on the Texas coast as 370 mm long. One fish taken 24 February 1958 at TS #6 was 445 mm in total length.

It is significant that none of these temperate zone fish were killed by the cold. All specimens were taken alive and vigorous among other dead fishes following cold spells.

TABLE 57

Catch records on *Micropogon undulatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#1	1	315	24.1	17.0
Jan. 28, 1957	TS#1	105	27-111	24.1	17.0
Jan. 28, 1957	TS#2	2	174	23.3	20.5
Jan. 28, 1957	TS#2	38	40-103	23.3	20.5
Jan. 28, 1957	TS#3	5	42-54	23.3	14.8
Jan. 28, 1957	TS#4	11	26-113	23.8	20.0
Jan. 28, 1957	TS#5	21	56-206	24.5	21.0
Jan. 28, 1957	TS#6	12	87-207	23.7	29.2
May 16, 1957	TS#1	7	73-275	26.0	10.0
May 16, 1957	TS#2	20	61-252	26.7	15.2
May 16, 1957	TS#3	8	36-70	26.5	5.4
May 16, 1957	TS#4	141	28-133	26.5	12.7
May 16, 1957	TS#4	1	214	26.5	12.7
May 16, 1957	TS#5	23	37-128	26.7	19.9
May 16, 1957	TS#6	11	39-137	26.7	22.9
June 18, 1957	TS#2	2	262-282	28.7	0.7
June 18, 1957	TS#2	195	25-145	28.7	0.7
June 18, 1957	TS#1	2	34-36	28.5	< 1.0
June 18, 1957	TS#4	88	22-98	29.3	< 1.0
June 18, 1957	TS#5	1	34	28.8	1.2
June 18, 1957	TS#6	4	30-46	28.3	22.8

TABLE 57

Catch records on *Micropogon undulatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	TS#5	11	95-180	28.3	22.8
Sept. 23, 1957	TS#2	19	94-127	28.1	0.17
Sept. 23, 1957	TS#2	1	242	28.1	0.17
Sept. 23, 1957	TS#3	1	100	23.1	0.17
Sept. 23, 1957	TS#4	7	114-170	22.9	0.18
Sept. 23, 1957	TS#4	1	266	22.9	0.18
Sept. 23, 1957	TS#5	2	268-329	23.8	0.20
Sept. 23, 1957	TS#5	93	114-170	23.8	0.20
Sept. 23, 1957	TS#6	25	83-140	23.4	0.34
Sept. 23, 1957	TS#6	2.	174-200	23.4	0.34
Sept. 23, 1957	TS#7	2	136-165	—	23.0
Nov. 13, 1957	TS#1	17	30-81	21.9	11.5
Nov. 13, 1957	TS#1	1	108	21.9	11.5
Nov. 13, 1957	TS#2	14	34-77	22.1	14.8
Nov. 13, 1957	TS#2	5	116-153	22.1	14.8
Nov. 13, 1957	TS#3	2	38-50	22.1	10.0
Nov. 13, 1957	TS#4	3	23-42	22.1	12.7
Nov. 13, 1957	TS#4	1	119	22.1	12.7
Nov. 13, 1957	TS#5	1	65	21.8	16.2
Nov. 13, 1957	TS#5	37	111-171	21.8	16.2
Nov. 13, 1957	TS#6	1	45	22.0	27.2
Nov. 13, 1957	TS#7	1	29	21.4	31.3
Jan. 27, 1958	TS#2	2	74-77	15.8	0.23
Jan. 27, 1958	TS#2	2	136-148	15.8	0.23
Jan. 27, 1958	TS#3	1	74	16.6	0.24
Jan. 27, 1958	TS#4	1	74	16.8	0.26
Jan. 28, 1958	TS#5	1	155	—	0.22
Jan. 28, 1958	TS#6	1	68	15.0	0.36
Jan. 28, 1958	TS#6	9	128-175	15.0	0.36
Jan. 28, 1958	TS#7	1	92	16.5	4.5
Jan. 28, 1958	TS#7	7	116-180	16.5	4.5
Feb. 24, 1958	TS#2	3	107-158	16.7	< 1.0
Feb. 24, 1958	TS#4	1	104	14.4	<< 1.0
Feb. 24, 1958	TS#5	1	92	14.4	< 1.0
Feb. 24, 1958	TS#6	7	139-205	16.1	7.0
Feb. 24, 1958	TS#6	1	445	16.1	7.0
Feb. 24, 1958	TS#7	8	95-180	18.9	29.4
Feb. 24, 1958	TS#7	8	210-285	18.9	29.4
Feb. 24, 1958	TS#7	2	304-375	18.9	29.4
Feb. 24, 1958	SS#1A	72	30-39	16.7	4 9
Feb. 24, 1958	SS#2	29	22-39	17.2	< 1.0
Feb. 24, 1958	SS#5	22	24-40	14.4	<< 1.0
Feb. 24, 1958	SS#6	36	16-35	17.8	< 1.0
May 19, 1958	TS#2	21	46-75	25.6	0.15
May 19, 1958		33	80-130	25.6	0.15
May 19, 1958	TS#3	10	86-103	25.6	0.27
May 19, 1958	TS#4	3	105-127	25.6	0.24
May 19, 1958	TS#4	17	49-93	25.6	0.24

TABLE 57
Catch records on *Micropogon undulatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 19, 1958	TS#5	103	44-127	25.6	0.15
May 19, 1958	TS#6	4	37-58	25.6	0.34
May 19, 1958	TS#6	108	72-139	25.6	0.34
May 19, 1958	TS#6	1	214	25.6	0.34
May 19, 1958	TS#7	35	107-176	26.7	25.5
May 19, 1958		19	190-268	26.7	25.5
May 19, 1958	SS#5	6	53-102	24.6	0.15
Oct. 27, 1958	TS#2	8	17-53	23.9	20.3
Oct. 27, 1958	TS#2	1	96	23.9	20.3
Oct. 28, 1958	TS#5	5	32-58	23.3	26.3
Oct. 28, 1958	TS#6	6	133-230	23.3	26.3
Oct. 27, 1958	TS#7	1	265	25.6	31.5
Jan. 27, 1959	TS#1	19	31-99	18.9	14.7
Jan. 27, 1959	TS#2	65	30-64	20.0	17.1
Jan. 27, 1959	TS#4	4	24-57	18.9	15.7
Jan. 27, 1959	SS#2	84	16-22	22.8	6.3
Jan. 27, 1959	SS#3	39	15-32	20.6	2.4
Jan. 27, 1959	SS#4	36	17-20	20.0	< 1.0
Jan. 27, 1959	SS#5	177	14-24	20.0	< 1.0
	Grand total	1965			

TABLE 58
Length frequency data on *Micropogon undulatus*

	Month	No. fish	Mode	Size limits	(mm.)
1957	Jan.	195	48	28	315
1957	May	210	43-68	28	268
1957	Sept.	153	108	88	328
1957	Nov.	83	43, 128	23	178
1958	Jan.	25	—	68	178
1958	May	308	58, 103	43	268
1959	Jan.	336	23	15	177

Pogonias cromis (Linnaeus). Black drum.

Table 59 shows that 24 black drum were taken in the trawls and mostly in moderate to high salinities. The size range was 205-467 mm in total length. None were seen killed by cold, and this is expected, for the black drum is a temperate rather than a tropical fish.

Sciaenops ocellata (Linnaeus). Red drum.

One hundred and twenty-seven fish were taken ranging from 12 to 104 mm in length. Small fish were taken in October, January and February, which corresponds to the well known fall and winter spawning for this fish on the northern Gulf. Catch records are given in table 60. The young came into the estuary whether the salinity was high or low

and the greatest numbers were taken when the salinity was high. This active fish is seldom taken in trawls or in small seines, except for the smaller specimens.

TABLE 59
Catch records of *Pogonias cromis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#2	2	223-335	23.3	20.5
Jan. 28, 1957	TS#4	1	218	23.8	20.0
May 16, 1957	TS#1	1	405	26.0	10.0
May 16, 1957	TS#2	1	308	26.7	15.2
June 18, 1957	TS#6	3	360-467	28.3	22.8
Nov. 13, 1957	TS#2	2	315-380	22.1	14.8
Nov. 13, 1957	TS#5	2	205-228	21.8	16.2
Jan. 28, 1958	TS#6	1	208	15.0	0.36
Jan. 28, 1958	TS#7	4	220-315	16.5	4.5
Feb. 24, 1958	TS#7	6	210-380	18.9	29.4
Oct. 28, 1958	TS#6	1	250	23.3	26.3
	Grand total	24			

TABLE 60
Catch records of *Sciaenops ocellata*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#1	20	19-44	24.6	29.0
Jan. 29, 1957	SS#2	16	12-22	24.1	20.0
Jan. 29, 1957	SS#3	48	17-38	24.9	14.0
Jan. 29, 1957	SS#4	31	16-30	24.3	17.0
Jan. 29, 1957	SS#4	3	92-104	24.3	17.0
Jan. 27, 1958	SS#5	1	47	17.4	0.35
Jan. 27, 1958	SS#1A	1	64	16.8	1.26
Feb. 24, 1958	SS#1A	1	30	16.7	4.9
Feb. 24, 1958	SS#6	1	35	17.8	< 1.0
Oct. 27, 1958	SS#3	1	26	25.0	7.8
Oct. 27, 1958	SS#6	2	60-65	24.4	19.0
Jan. 27, 1959	SS#3	2	33-39	20.6	2.4
	Grand total	127			

Stellifer lanceolatus (Holbrook). Stardrum.

Catch records are given in table 61. Only four fish were taken. It is not often taken in low salinity waters. Gunter (1945) reported 8.9 as the lowest salinity where the fish was caught in Texas, but we took a 20 mm specimen in May at a salinity of 1.04 o/oo. This small fish

was taken at the time expected from known spawning dates (Gunter, *op.cit.*).

TABLE 61
Catch records of *Stellifer lanceolatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Feb. 24, 1958	TS#6	1	122	16.1	7.0
Feb. 24, 1958	TS#7	2	93-118	18.9	29.4
May 20, 1958	SS#1A	1	20	25.6	1.04

Cynoscion nebulosus (Cuvier and Valenciennes). Spotted squeteague.

This fish seems not to be abundant in the St. Lucie. One specimen was taken at SS #3 on 16 May 1957. It was 52 mm long. The water temperature was 28.3°C and the salinity was 3.7.

Cynoscion regalis (Bloch and Schneider). Weakfish.

Weakfish have not been reported previously as far south as the St. Lucie Estuary. For that reason the senior author checked specimens with Mr. Isaac Ginsburg, the taxonomic authority on the group. Catch records are shown in table 62. One hundred and thirty-one fish were caught, all in the trawls except two. The size range was 34 to 280 mm. The fish were generally taken in moderate to high salinities but 35 specimens, especially smaller fish, were taken in fresh water and the species is euryhaline. Fish 34 and 35 mm long were taken in June and September. There is probably a long spawning season.

SPARIDAE

Archosargus probatocephalus (Walbaum). Sheepshead.

On 13 November 1957 three sheepshead, ranging from 187 to 232 mm in length, were taken at TS #4 at a temperature of 22.1°C and a salinity of 12.7. On 27 January 1958 at the same station two more fish were caught. They were 26.8 and 27.9 mm long. The bottom water temperature was 16.8. The salinity was 0.26 o/oo.

Lagodon rhomboides (Linnaeus). Pinfish.

Catch records are given in table 63. Nearly all specimens were larvae or juveniles. The very smallest specimens were taken in May, but small fish were also taken in January. Gunter (1945) and previous workers found this fish to be a winter spawner. However, Springer and Woodburn seem to think the pinfish spawns a couple of months later in south Florida. Our data indicate that both ideas are correct.

EPHIPPIDAE

Chaetodipterus faber (Broussonet). Spadefish.

Twenty-one fish were caught at moderate to higher salinities. The

data are given in table 64. The smallest fish was taken in September. Springer and Woodburn took smaller fish from June to September.

TABLE 62

Catch records of *Cynoscion regalis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#2	1	167	23.3	20.5
Jan. 28, 1957	TS#5	6	127-180	24.5	21.0
Jan. 28, 1957	TS#6	5	72-280	23.7	29.2
May 16, 1957	TS#1	2	73-74	26.0	10.0
May 16, 1957	TS#5	2	108-113	26.7	19.9
June 18, 1957	TS#2	2	102-113	28.7	0.7
June 18, 1957	TS#4	1	35	29.3	< 1.0
Sept. 23, 1957	TS#5	6	50-197	23.8	0.20
Sept. 23, 1957	TS#6	6	34-237	23.4	0.34
Nov. 13, 1957	TS#1	1	93	21.9	11.5
Nov. 13, 1957	TS#2	7	45-206	22.1	14.8
Nov. 13, 1957	TS#4	2	62-100	22.1	12.7
Nov. 13, 1957	TS#5	8	109-187	21.8	16.2
May 19, 1958	TS#2	5	67-83	25.6	0.15
May 19, 1958	TS#3	4	42-79	25.6	0.27
May 19, 1958	TS#4	6	48-75	25.6	0.22
May 19, 1958	TS#5	13	63-93	25.6	0.15
May 19, 1958	TS#6	12	31-78	25.6	0.34
May 19, 1958	TS#7	1	230	24.4	25.5
May 19, 1958	SS#6	2	48-71	26.1	0.30
Oct. 27, 1958	TS#1	1	109	23.9	7.8
Oct. 27, 1958	TS#2	2	201-233	23.9	20.3
Oct. 27, 1958	TS#2	28	44-139	23.9	20.3
Oct. 27, 1958	TS#4	3	47-91	25.6	20.2
Oct. 27, 1958	TS#5	2	57-90	23.3	26.3
Oct. 27, 1958	TS#6	3	62-272	23.3	26.3
	Grand total	131			

TABLE 63

Catch records of *Lagodon rhomboides*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#3	2	20-22	24.9	14.0
May 16, 1957	SS#3	6	38-82	28.3	3.7
June 18, 1957	SS#6	1	52	—	2.7
June 18, 1957	TS#5	1	75	28.8	1.2
June 18, 1957	SS#5	1	87	—	< 1.0
Jan. 27, 1958	SS#1A	1	22	16.8	1.26
May 19, 1958	SS#2	8	31-65	20.6	0.19
May 19, 1958	SS#3	23	29-47	25.6	0.28

TABLE 63

Catch records of *Lagodon rhomboides*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 19, 1958	SS#5	2	19-34	24.4	0.15
May 20, 1958	SS#1A	1	10	25.6	1.04
Jan. 27, 1959	SS#3	1	30	20.6	2.4
	Grand total	47			

TABLE 64

Catch records of *Chaetodipterus faber*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Sept. 23, 1957	TS#7	1	18	—	23.0
Feb. 24, 1958	TS#7	1	108	18.9	29.4
Oct. 28, 1958	TS#6	18	36-81	23.3	26.3
Jan. 27, 1959	TS#1	1	70	18.9	14.7
	Grand total	21			

POMACENTRIDAE

Abudefduf saxatilis (Linnaeus). Sergeant major.

One specimen was taken in the outer estuary on 28 January 1957, but the station is unknown.

TRICHIURIDAE

Trichiurus lepturus Linnaeus. Cutlass fish.

One fish 727 mm long was taken on 27 January 1958 at TS #7, where the bottom temperature was 16.5°C and the salinity was 4.5.

GOBIIDAE

Bathygobius soporator (Cuvier and Valenciennes). Goby.

One fish 23 mm long was taken at SS #1A on 27 January 1958. The temperature was 16.8 and the salinity was 1.26.

Gobionellus boleosoma (Jordan and Gilbert). Darter goby.

Catch records are shown in table 65. This species was caught more often than any other goby. Most specimens were taken in low salinities or fresh water, but one fish was taken at a fairly high salinity. The smallest fish was taken in January. Gunter (1945) found the smallest fish in Texas waters in January. The species appears to be euryhaline.

TABLE 65
Catch records of *Gobionellus boleosoma*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 27, 1958	SS#5	2	19-30	17.4	0.35
Jan. 27, 1958	SS#1A	8	23-32	16.8	1.26
Jan. 27, 1958	TS#2	1	88	15.8	0.23
Feb. 24, 1958	TS#2	1	60	16.7	< 1.0
Feb. 24, 1958	SS#1A	14	28-35	16.7	4.9
Feb. 24, 1958	SS#5	2	26-28	14.4	< 1.0
May 19, 1958	TS#4	1	34	25.6	0.24
May 19, 1958	SS#3	2	30-33	25.6	0.28
May 19, 1958	SS#4	2	41-52	26.1	0.14
May 20, 1958	TS#6	2	35-41	25.6	0.34
May 20, 1958	SS#1A	14	26-36	25.6	1.04
Jan. 27, 1959	SS#1A	2	27-38	21.1	25.9
	Grand total	51			

Gobionellus gracillimus (Ginsburg). Sharptail goby.

The writers feel that the taxonomy of the *gracillimus-hastatus-oceanicus* is in an unsettled state and at present we put little faith in published identifications. Nevertheless, we checked some of our specimens of this species with Mr. Isaac Ginsburg and table 66 gives the determinations as we made them in the field.

TABLE 66
Catch records of fish identified as *Gobionellus gracillimus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 27, 1957	TS#2	1	47	23.3	20.5
Jan. 27, 1957	TS#5	1	73	24.5	21.0
May 16, 1957	TS#5	1	67	26.7	19.9
May 16, 1957	TS#6	1	68	26.7	22.9
Sept. 23, 1957	TS#6	1	103	23.4	0.34
Nov. 13, 1957	TS#6	1	80	22.1	27.2
Jan. 27, 1958	TS#3	1	112	16.6	0.24
Jan. 27, 1959	TS#5	1	120	20.0	22.2
Jan. 27, 1959	TS#6	2	55-75	—	24.0
	Grand total	10			

Gobionellus hastatus (Girard). Sharptailed goby.

There was overlap with *G. gracillimus* and *G. hastatus* in size of the tail. Some were quite short and some were very long. Table 67 gives the catch records. Some specimens were taken in very low salinity water.

TABLE 67

Catch records of fish identified as *Gobionellus hastatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1958	TS#6	1	128	15.0	0.36
Jan. 28, 1958	TS#7	1	156	16.5	4.5
May 19, 1958	TS#4	1	124	25.6	0.24
May 19, 1958	TS#5	3	35-84	25.6	0.15
May 19, 1958	TS#7	1	67	24.4	25.5
	Grand total	7			

Gobiosoma bosci. (Lacepède). Naked goby.

One specimen was taken on 16 May 1957 at TS #1. It was 33 mm long. The salinity was 10.0 and the temperature was 26.0°C.

Gobioides broussonneti (Lacepede). Violet goby.

Catch records are given in table 68. The fish was taken in fresh water and once at a high salinity. One was the largest specimen ever reported. The species appears to be euryhaline. Specimens killed by the cold were seen on 24 February 1958.

TABLE 68

Catch records of *Gobioides broussonneti*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	TS#2	1	331	28.7	0.7
Jan. 28, 1958	TS#5	2	350-590	—	0.22
Feb. 24, 1958	TS#2	3	250-455 (dead)	16.7	<1.0
Feb. 24, 1958	TS#5	4	398-484 (dead)	14.4	<1.0
Feb. 24, 1958	TS#6	1	555	16.1	7.0
May 19, 1958	TS#4	1	290	25.6	0.24
May 19, 1958	TS#7	1	320	26.7	25.5
	Grand total	13			

SPHYRAENIDAE

Sphyraena barracuda (Walbaum). Great barracuda.

One little fish 31 mm long was taken at SS #6 on 18 June 1957. The salinity was 2.7.

MUGILIDAE

Mugil curema (Cuvier and Valenciennes). Silver mullet.

Catch records are given in table 69. Juvenile fish were taken in June and in fact the species was only seen in May and June.

TABLE 69
Catch records of *Mugil curema*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	SS#3	1	169	28.3	3.7
May 16, 1957	SS#4	1	156	28.0	9.5
June 18, 1957	SS#4	11	40-62	29.0	< 1.0
May 19, 1958	SS#3	1	200	25.6	0.28
	Grand total	14			

TABLE 70
Catch records of *Mugil cephalus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#1	378	18-33	24.6	29.0
Jan. 29, 1957	SS#3	44	24-33	24.9	14.0
Jan. 29, 1957	SS#4	10	26-29	24.3	17.0
Jan. 29, 1957	SS#5	49	23-28	24.0	19.3
May 16, 1957	SS#2	6	23-28	30.7	9.3
May 16, 1957	SS#3	22	28-74	28.3	3.7
May 16, 1957	SS#4	104 (4	124-249	28.0	9.5
		(100	23-95		
May 16, 1957	SS#5	24	querimana stage	28.0	5.7
June 18, 1957	SS#4	65 (4	152-170	29.0	< 1.0
		(61	20-82		
June 18, 1957	TS#4	1	35	29.8	< 1.0
June 18, 1957	SS#6	6	28-35	—	2.7
June 18, 1957	TS#5	1 (dead)	405	28.3	1.2
June 18, 1957	SS#5	2	61-241	—	< 1.0
Nov. 13, 1957	SS#1A	1	21	29.8	21.6
Nov. 13, 1957	SS#6	1	141	—	23.1
Jan. 28, 1958	SS#1A	676	querimana stage	16.8	1.3
Jan. 28, 1958	SS#1A	2	121-132	16.8	1.3
Jan. 28, 1958	SS#2	175	25-30	—	0.34
Jan. 28, 1958	SS#2	2	122-225	—	0.34
Jan. 27, 1958	SS#3	428	24-32	17.7	0.26
Jan. 27, 1958	SS#4	2	93-127	—	0.25
Jan. 27, 1958	SS#4	1,178	21-33	—	0.25
Jan. 27, 1958	SS#5	104	21-31	17.4	0.35
Jan. 28, 1958	SS#6	2,050	21-31	—	0.32
Jan. 27, 1958	TS#6	1	283	15.0	0.36
Feb. 24, 1958	TS#6	2	242-258	16.1	7.0
Feb. 24, 1958	SS#1A	230	20-34	16.7	4.9
Feb. 24, 1958	SS#2	650	25-36	17.2	< 1.0
Feb. 24, 1958	SS#3	1,220	28-34	16.7	< 1.0

TABLE 70
Catch records of *Mugil cephalus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Feb. 24, 1958	SS#4	288	25-35	14.4	< 1.0
Feb. 25, 1958	SS#5	2,900	21-35	17.2	< 1.0
Feb. 24, 1958	SS#6	766	26-31	17.8	< 1.0
May 19, 1958	SS#3	55	32-59	25.6	0.28
May 19, 1958	SS#4	408	34-78	26.1	0.14
May 20, 1958	SS#6	1	54	26.1	0.30
Oct. 27, 1958	SS#6	9	22-24	24.4	19.0
Jan. 27, 1959	SS#1A	1	26	21.1	25.9
Jan. 27, 1959	SS#2	88	21-33	22.8	6.3
Jan. 27, 1959	SS#3	4	22-24	20.6	2.4
Jan. 27, 1959	SS#4	105	21-27	20.0	< 1.0
Jan. 27, 1959	SS#5	331	22-29	20.0	< 1.0
Jan. 27, 1959	SS#6	1	150	22.2	10.4
	Grand total	12,391			

Mugil cephalus (Linnaeus). riped mullet.

The striped mullet was very abundant in the minnow seine hauls. Table 70 shows that 12,391 specimens were taken. Only five specimens were taken in the trawls and one of these was dead. Gunter (1945 and previously) has remarked upon the general absence of this species in trawl catches. The fish generally stays close to shore in shallow waters where larger individuals may be caught in great numbers in large nets, which were not used in this investigation. Table 70 shows that the young, many of them in the querimana stage, were taken from November to May, with the greatest numbers in January and February. There is evidently a long breeding season from fall to spring with a peak in early winter. By far the greatest number of mullet were taken in waters of very low salinity, within or close to the freshwater range, during the time when the spillway was open. In fact, only 493 fish were taken at salinities above 15 parts per thousand and almost 12,000 were caught at lower salinities. The writers fished by stations and did not attempt to accumulate large numbers of specimens merely for the sake of numbers alone. In one haul on February 25, 1958 we caught 2,900 mullet. Attempts to catch small mullet in the numerous shoals which were seen along shore from time to time could have easily resulted in several hundred thousand fish caught in one day.

ATHERINIDAE

Membras martinica (Valenciennes). Rough silverside.

Only 10 specimens were caught, all in seine hauls on 29 January 1957 at intermediate salinities. The data are given in table 71. This little fish is apparently as uncommon on the east coast of southern Florida as it is on the west coast, where Springer and Woodburn took

only 2 fish of this genus among several thousand specimens. Gunter (1945) and Reid (1954) found this species more abundant in the shallow waters of the northern Gulf.

Menidia beryllina (Cope). Silverside.

We took 1,708 specimens, all at seine stations at salinities ranging from fresh water to 29.8 *per mille*. An examination of table 72 shows that the greatest numbers were taken in low salinity waters. In fact only 294 fish were taken at salinities above 1.0 and only 69 were taken at salinities above 3.0 Fifty-six fish per haul were taken in twenty-nine hauls in low salinity (<3.0) and only fourteen per haul at five higher salinity stations. Gunter (1945) and Springer and Woodburn (1960) found that the fish is almost oblivious to salinity, although the larger specimens tend to be taken in the saltier water.

Hildebrand and Schroeder (1928) found that this fish had two spawning peaks a year in Chesapeake Bay. Gunter (*op. cit.*) found a spawning peak in the spring and another in the fall in Texas waters, and Springer and Woodburn (*op. cit.*) found the same thing on the west coast of south Florida. Our data show the same thing. The very smallest fish were taken in September in 1957 and in May 1958. Four investigations, thirty-two years apart in time and over a thousand miles in space show the same thing. It is certain that *Menidia beryllina* spawns twice during the warm season and the young enter the population in the late spring and early fall.

Total length measurements were made of all specimens, but the length frequency curves are scattered by three month gaps and show nothing not previously presented by Gunter (1945) and Springer and Woodburn. Therefore, they are not presented.

TABLE 71
Catch records of *Membras martinica*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#3	1	51	24.9	14.0
Jan. 29, 1957	SS#4	5	47-65	24.3	17.0
Jan. 29, 1957	SS#5	4	52-62	24.0	19.3

TABLE 72
Catch records of *Menidia beryllina*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	SS#4	9	23-47	29.0	< 1.0
June 18, 1957	SS#6	36	25-44	—	2.7
June 18, 1957	SS#2	1	30	30.0	0.8
June 18, 1957	SS#5	17	25-44	—	< 1.0
		63			

TABLE 72
Catch records of *Menidia beryllina*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Sept. 23, 1957	SS#1A	10	17-29	31.1	7.5
Sept. 23, 1957	SS#2	145	17-34	30.0	0.19
Sept. 23, 1957	SS#3	1	30	28.6	0.17
Sept. 23, 1957	SS#4	15	23-44	28.1	0.16
Sept. 23, 1957	SS#5	162	13-48	29.5	0.18
Sept. 23, 1957	SS#6	23	20-34	30.9	0.25
		356			
Nov. 13, 1957	SS#1A	5	26-33	21.6	29.8
Nov. 13, 1957	SS#5	1	29	21.6	14.5
Nov. 13, 1957	SS#6	10	21-38	—	23.1
		16			
Jan. 27, 1958	SS#4	9	24-40	0	0.25
Jan. 27, 1958	SS#3	8	25-42	17.7	0.26
Jan. 27, 1958	SS#5	133	22-52	17.4	0.35
Jan. 27, 1958	SS#1A	32	20-34	16.8	1.26
Jan. 27, 1958	SS#2	89	20-69	—	0.34
Jan. 27, 1958	SS#6	4	22-32	—	0.32
		275			
Feb. 24, 1958	SS#1A	4	32-40	16.7	4.9
Feb. 24, 1958	SS#2	7	50-81	17.2	< 1.0
Feb. 24, 1958	SS#2	22	21-42	17.2	< 1.0
Feb. 24, 1958	SS#3	127	20-51	16.7	< 1.0
Feb. 24, 1958	SS#4	3	27-37	14.4	< 1.0
Feb. 24, 1958	SS#4	4	51-77	14.4	< 1.0
Feb. 25, 1958	SS#5	44	20-44	17.2	< 1.0
Feb. 24, 1958	SS#6	23	20-33	17.8	< 1.0
		234			
May 20, 1958	SS#1A	175	19-32	25.6	1.04
May 19, 1958	SS#2	28	17-40	26.1	0.19
May 19, 1958	SS#3	24	23-34	25.6	0.28
May 19, 1958	SS#4	33	19-24	26.1	0.14
May 19, 1958	SS#5	45	18-45	24.4	0.15
May 20, 1958	SS#6	425	15-38	26.1	0.30
		730			
Oct. 27, 1958	SS#3	19	28-44	25.0	7.8
Oct. 27, 1958	SS#6	2	38-44	24.4	19.0
		21			
Jan. 27, 1959	SS#5	11	44-61	20.0	< 1.0
	Grand total	1,708			

SCORPAENIDAE

Scorpaena grandicornis Valenciennes. Scorpion fish.

One specimen was caught on 16 May 1957 at TS #7. It was 104 mm long. The water temperature was 28.0°C and the salinity was 25.7 o/oo.

TRIGLIDAE

Prionotus tribulus (Valenciennes). Sea robin.

Four specimens were taken in January 1957 and January 1958. The catch records are given in table 73. Gunter (1945) found the least numbers of this fish in summer in Texas waters. Springer and Woodburn (1960) took the species only from October to February. Kilby (1956) only took this species from October to February in the marsh areas of Cedar Keys, Florida. Reid (1954) found the species most abundant in the waters off Cedar Keys from November through March. It is clear that this triglid moves inshore during the cooler months of the year. At this time it ventures into low salinity water and we took one specimen at a salinity of 6.3, the lowest yet recorded for this species.

Gunter (1945) took his smallest specimens (35 mm) in March. We took two 28 mm long in January. Apparently the fish spawns in the late fall or early winter.

TABLE 73
Catch records of *Prionotus tribulus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	TS#6	1	28	23.7	29.2
Jan. 29, 1957	SS#2	1	28	24.1	20.0
		2			
Jan. 27, 1959	SS#2	1	96	22.8	6.3
Jan. 27, 1959	TS#1	1	108	18.9	14.7
		2			

BOTHIDAE

Citharichthys macrops Dresel

One specimen 61 mm long was taken at TS #7 on 16 May 1957. The temperature was 28.0°C and the salinity was 25.7. This offshore species is not commonly taken inshore.

Citharichthys spilopterus (Günther).

Ninety-two specimens were caught at salinities ranging from 0.15 (which is fresh water) to 29.2. Most fish were taken above 20.0 *per mille* salinity and below 5.0. The smallest specimens were taken in May 1957 and 1958. This species was not recorded by Springer and Woodburn in the Tampa region. Gunter (1945) found the smallest fish in April in south Texas. Apparently the species spawns in early spring. In the Texas region Gunter found that this fish moves out of the bays and offshore in the winter, but there were no signs of such a movement in the St. Lucie, where several specimens were taken in midwinter. All but ten specimens were taken in trawls. Similarly Gunter caught only 5 out of 75 specimens in seines and apparently the fish does not com-

monly inhabit the shallows near shore. This is probably the explanation of the hiatus of Springer and Woodburn with regard to this species for those authors collected only with seines. Our catches are recorded in table 74.

TABLE 74
Catch records of *Citharichthys spilopterus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#2	1	28	23.3	20.5
Jan. 28, 1957	TS#4	2	40-69	23.8	20.0
Jan. 28, 1957	TS#5	4	40-48	24.5	21.0
Jan. 28, 1957	TS#6	9	44-74	23.7	29.2
May 16, 1957	TS#2	2	66-82	26.7	15.2
May 16, 1957	TS#4	4	25-84	26.5	12.7
May 16, 1957	TS#5	5	36-103	26.7	19.9
May 16, 1957	TS#6	3	57-112	26.7	22.9
June 18, 1957	TS#2	1	52	28.7	0.7
June 18, 1957	TS#6	2	34-90	28.3	22.8
Sept. 23, 1957	SS#4	2	79-87	28.1	0.16
Nov. 13, 1957	TS#6	2	46-59	21.6	22.0
Jan. 27, 1958	SS#4	1	29	—	0.25
Jan. 27, 1958	SS#1A	2	38-39	16.8	1.26
Jan. 28, 1958	TS#6	1	60	15.0	0.36
Jan. 27, 1958	TS#7	2	42-50	16.5	4.5
May 19, 1958	TS#2	8	30-53	25.6	0.15
May 19, 1958	TS#3	4	36-52	25.6	0.27
May 19, 1958	TS#4	18	19-62	25.6	0.24
May 19, 1958	TS#5	5	26-71	25.6	0.15
May 20, 1958	TS#7	2	42-47	24.4	25.5
May 19, 1958	SS#3	1	47	25.6	0.28
May 19, 1958	SS#5	2	78-78	24.4	0.15
May 20, 1957	SS#6	1	28	26.1	0.30
Oct. 27, 1958	TS#6	1	94	23.3	26.3
Jan. 27, 1959	TS#2	1	54	20.0	17.1
Jan. 27, 1959	TS#4	1	64	18.9	15.7
Jan. 27, 1959	TS#5	1	61	20.0	22.2
Jan. 27, 1959	TS#6	3	78-110	—	24.0
Jan. 27, 1959	SS#1	1	47	21.1	25.9
	Grand total	92			

TABLE 75
Catch records of *Etropus crossotus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	TS#6	4	94-136	23.7	29.2
June 18, 1957	TS#6	1	80	28.3	22.8

TABLE 75
Catch records of *Etropus crossotus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 20, 1958	TS#7	1	47	24.4	25.5
Jan. 27, 1959	TS#6	1	120	21.1	24.0
Jan. 27, 1959	TS#7	1	125	22.2	33.8
	Grand total	8			

Etropus crossotus (Jordan and Gilbert).

Only 8 specimens were caught, as shown in table 75, and all of them were taken in trawls. The salinity ranges were all high, 22.8-33.8. In Texas waters, Gunter (*op. cit.*) took only one of 210 specimens in seines, and the remainder were taken in trawls. Springer and Woodburn took only one specimen in the Tampa region and concluded that the species is rarer there than in northwest Florida. That my be true but we believe that trawling in deeper water there would yield more specimens. Our collections in the St. Lucie are in agreement with Gunter's (1945, p. 86) previous conclusion that "the fish does not like brackish waters."

SOLEIDAE

Achirus lineatus (Linnaeus). Lined sole.

Nine specimens were caught, (table 76), one in fresh water. This salinity, 0.18, is the lowest at which the species has been reported and the species must be added to the list of euryhaline fishes.

Trinectes maculatus (Bloch and Schneider). Broad sole.

Sixty-nine fish were caught ranging in total length from 25-148 mm (table 77). Three specimens carrying eggs were noted on 19 May 1958. They were 115-138 mm long. The smallest fish, 25-34 mm long, were taken in the months of September and October. The smallest fish Gunter (*op. cit.*) took in Texas were 51 mm long and they were taken in November and December. The available evidence points to a summer spawning.

It is well known that this species is euryhaline. Twenty-three of the St. Lucie specimens were taken at salinities within the fresh water range. There was some relation between salinity and size as Springer and Woodburn previously noted. Fish taken in the fresh water range averaged 83 mm in length, while those taken at salinities above 20.0 were 104 mm in average length.

Symphurus plagiusa (Linnaeus). Tonguefish.

Twenty-one specimens were caught. The data are given in table 78. The size range was 29-134 mm. The smallest fish was taken in October which is the same month that Springer and Woodburn found the smallest tonguefish in Tampa Bay.

Gunter (1945) found the salinity range of this fish in south Tex-

as waters to be 17.1-36.7, but Springer and Woodburn found the fish at salinities of 5.0-33.0 in Tampa Bay. In the St. Lucie Estuary, the fish were taken where the salinities ranged from <1.0 to 24.0. Four fish were taken at salinities below 7.0 and the remainder were in water with salinities above 19.0.

TABLE 76
Catch records of *Achirus lineatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Sept. 23, 1957	TS#4	1	31	22.9	0.18
Nov. 13, 1957	TS#4	5	27-45	22.1	12.7
Nov. 13, 1957	TS#3	3	35-40	22.1	10.1
	Grand total	9			

TABLE 77
Catch records of *Trinectes maculatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#5	1	105	24.5	21.0
May 16, 1957	TS#1	2	118-130	26.0	10.0
May 16, 1957	TS#5	1	125	26.7	19.9
June 18, 1957	TS#2	1	134	28.7	0.7
June 18, 1957	TS#4	1	60	29.3	< 1.0
Sept. 18, 1957	TS#3	2	25-30	23.1	0.17
Sept. 18, 1957	TS#5	1	25	23.8	0.20
Sept. 18, 1957	TS#6	1	39	23.4	0.34
Nov. 13, 1957	TS#5	1	80	21.8	16.2
Nov. 13, 1957	TS#6	1	80	22.0	27.2
Jan. 27, 1958	TS#2	4	81-145	15.8	0.23
Jan. 27, 1958	TS#3	2	73-100	16.6	0.24
Jan. 28, 1958	TS#5	3	100-130	—	0.22
Jan. 28, 1958	TS#6	4	74-147	15.0	0.36
Jan. 27, 1958	TS#7	11	94-135	16.5	4.5
Feb. 24, 1958	TS#1	1	72	14.5	< 1.0
Feb. 24, 1958	TS#2	6	96-128	16.7	< 1.0
Feb. 24, 1958	TS#3	1	85	18.9	< 1.0
Feb. 24, 1958	TS#6	1	128	16.1	7.0
Feb. 24, 1958	TS#7	3	95-148	18.9	29.4
May 19, 1958	TS#3	3	82-132	25.6	0.27
May 19, 1958	TS#4	1	46	25.6	0.24
May 19, 1958	TS#6	1	115	25.6	0.34
May 19, 1958	TS#7	9	101-140	24.4	25.5
Oct. 27, 1958	TS#1	1	145	23.9	7.8
Oct. 27, 1958	TS#2	3	34-34-102	23.9	20.3
Jan. 27, 1959	TS#2	1	140	20.0	17.1

TABLE 77
Catch records of *Trinectes maculatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 27, 1959	TS#3	1	135	18.9	13.8
Jan. 27, 1959	TS#5	1	128	20.0	22.2
	Grand total	69			

TABLE 78
Catch records of *Symphurus plagiusa*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#2	1	47	23.3	20.5
Jan. 28, 1957	TS#4	2	59-86	23.8	20.0
Jan. 28, 1957	TS#5	1	80	24.5	21.0
May 16, 1957	TS#6	4	109-134	26.7	22.9
Jan. 27, 1958	TS#7	1	147	16.5	4.5
Feb. 24, 1958	SS#3	1	37	16.7	< 1.0
Feb. 24, 1958	TS#6	1	35	16.1	7.0
Feb. 24, 1958	SS#1A	1	42	16.7	4.9
Oct. 27, 1958	TS#2	5	40-56	23.9	20.3
Oct. 27, 1958	TS#4	1	55	25.6	20.2
Oct. 27, 1958	SS#6	1	29	24.4	19.0
Jan. 27, 1959	TS#5	1	76	20.0	22.2
Jan. 27, 1959	TS#6	1	75	21.1	24.0
	Grand total	21			

TETRAODONTIDAE

Sphoeroides maculatus (Bloch and Schneider). Marbled puffer.

Catch records are given in table 79. The three fish were all taken at fairly high salinities, 22.8-27.4. A 21 mm fish was taken in November 1957.

Sphoeroides testudineus (Linnaeus). Northern puffer.

Table 80 shows that twenty fish of wide size range were taken in various months and at surprisingly varied salinities, 0.36 (not quite fresh water) to 29.4. A ten mm fish was taken in January, an 18 mm fish in May and a 17 mm fish in November. Evidently the breeding season is a long one.

DIODONTIDAE

Chilomycterus schoepfi (Walbaum).

Three fish were caught in high salinity water, 29.2 to 36.0 (table 81). A 15 mm fish was taken in January.

TABLE 79
Catch records of *Sphoeroides maculatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	TS#6	1	180	28.3	22.8
Nov. 13, 1957	SS#6	1	21	—	23.1
Oct. 27, 1958	SS#1A	1	47	25.6	27.4
	Grand total	3			

TABLE 80
Catch records of *Sphoeroides testudineus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#5	1	127	24.5	21.0
Jan. 29, 1957	TS#6	1	91	23.7	29.2
Jan. 28, 1957	SS#2	1	10	24.1	20.0
May 16, 1957	TS#6	1	155	26.7	22.9
May 16, 1957	SS#1A	1	158	28.0	21.5
May 16, 1957	SS#2	2	18-257	30.7	9.3
Sept. 23, 1957	TS#7	1	132	—	23.0
Nov. 13, 1957	SS#1A	1	17	21.6	29.8
Jan. 28, 1958	TS#6	1	215	15.0	0.36
Feb. 24, 1958	TS#7	4	154-190	18.9	29.4
May 20, 1958	SS#1A	2	135-145	25.6	1.04
Jan. 27, 1959	TS#4	1	41	18.9	15.7
Jan. 27, 1959	SS#1A	2	106-141	21.1	25.9
Jan. 27, 1959	SS#2	1	30	22.8	6.3

TABLE 81
Catch records of *Chilomycterus schoepfi*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	TS#6	1	15	23.7	29.2
Jan. 29, 1957	TS#7	1	140	22.2	36.0
May 16, 1957	TS#7	1	182	25.7	32.4

LEPTOCEPHALI

Seventy-nine leptocephali were taken in seines in the months of January and February (table 82). The size range was 33-43 mm and the salinity range where they were taken was 0.32 to 25.9 *per mille*. These larvae could have belonged to *Albula, Elops, Megalops* or some species of eel and we venture no guess as to the identification.

TABLE 82

Catch records of *Leptocephali*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	SS#1	4	35-39	24.6	29.0
Jan. 29, 1957	SS#4	16	33-43	24.3	17.0
Jan. 28, 1958	SS#1	4	35-42	16.8	1.26
Jan. 28, 1958	SS#5	1	42	17.4	0.35
Jan. 28, 1958	SS#6	40	35	—	0.32
Feb. 24, 1958	SS#1A	1	—	16.7	4.9
Feb. 24, 1958	SS#6	1	—	17.8	< 1.0
Jan. 27, 1959	SS#1A	12	—	21.1	25.9
	Grand total	79			

3. *Invertebrate catch.* — Table 83, which lists the most abundant invertebrate animals caught, is in considerable contrast to table 12, which is the comparable one for fishes, in that no great predominance of a few numerous species is demonstrated. However, the jelly-like ctenophores could not be counted, and it was noted that the trawl hauls sometimes consisted virtually of a mass of jelly with the remaining less numerous organisms interspersed. If there was any dominant invertebrate it was the ctenophore, *Mnemiopsis*. The remaining most abundant invertebrates were two commercial shrimp, *Penaeus aztecus* and *P. duorarum;* two swimming crabs, *Callinectes;* a jellyfish; a small clam; and a small marine snail. Only one of the invertebrates, the river shrimp, *Macrobrachium*, was a fresh-water species. The three *Palaemonetes* shrimp noted are difficult to define. At least two of them seem to be estuarine or marine. Several of the invertebrates, such as the squid, chiton, stone shrimp, and sea hare, were taken only in fairly high salinities and only a few times, as indicated in table 84.

TABLE 83

Most abundant invertebrate animals caught in each of the three main areas of St. Lucie Estuary

Species	Number of each species caught			
	South Fork	North Fork	Outer Estuary	Total
Mnemiopsis mccradyi (ctenophore)	Numerous	Few	Numerous	Numerous
Aurellia aurita (jellyfish)	Numerous	Few	Numerous	Numerous
Penaeus aztecus (brown shrimp)	248	76	167	491
Penaeus duorarum (pink shrimp)	156	35	32	223
Callinectes sapidus (blue crab)	75	32	87	194
Callinectes ornatus (ornate crab)	29	3	100	132
Mulinia lateralis (clam)	—	—	127	127
Nassarius vibex (common nassa)	—	1	126	127

TABLE 83

Most abundant invertebrate animals caught in each of the three main areas of St. Lucie Estuary

Species	Number of each species caught			
	South Fork	North Fork	Outer Estuary	Total
Rangia cuneata (rangia clam)	5	76	6	87
Palaemonetes spp. (grass shrimp)	16	16	17	49
Macrobrachium acanthurus (river shrimp)	12	10	13	35
Clibanarius vitattus (hermit crab)	1	1	25	27
Penaeus fluviatilis (white shrimp)	16	—	1	17
Congeria leucophaeta	Few	Several		—
Aplysia willcoxi (sea hare-inkfish)	—	—	11	11

TABLE 84

Average salinity and range at which invertebrate animals were collected in St. Lucie Estuary

Species	Salinity (p.p.t.)	
	Average	Range
Pagurus pollicaris (hermit crab)	36.0	36.0
Paguristes hummi (hermit crab)	36.0	36.0
Calliactes tricolor (sea anemone)	36.0	36.0
Arca sp. (ark shell)	36.0	36.0
Canthurus multangulus	33.8	33.8
Ophiothrix örstedii (serpent star)	33.8	33.8
Chaetopleura apiculata (chiton)	33.8	33.8
Astropecten articulatus (starfish)	33.8	33.8
Clathrodrillia ostrearum	33.8	33.8
Aplysia willcoxi (sea hare-inkfish)	33.0	29.2-36.0
Sicyonia typica (stone shrimp)	29.2	29.2
Lolliguncula brevis (squid)	28.0	27.2-29.2
Mulinia lateralis (clam)	25.2	20.0-29.2
Solen viridis (razor clam)	22.9	22.9
Polinices duplicata (mooneye)	22.8	22.8
Crepidula plana	22.8	22.8
Mnemiopsis mccradyi (comb jelly)	21.2	13.8-33 8
Congeria leucophaeta	20.2	20.2-20.3
Aurellia aurita (moon jelly)	20.2	7.8-32.4
Penaeus duorarum (pink shrimp)	19.9	13.8-27.4
Nassarius vibex (common nassa)	19.0	0.34-29.4
Callinectes ornatus (ornate crab)	18.9	0.34-36.0
Cancroid crab	18.8	7.8-36.0
Clibanarius vitattus (hermit crab)	17.5	2.34-36.0
Palaemonetes vulgaris (grass shrimp)	16.5	3.7-39.2
Molgula manhattensis (onion tunicate)	15.1	10.0-20.2
Penaeus fluviatilis (white shrimp)	14.0	0.7-21.0
Penaeus aztecus (brown shrimp)	13.4	0.22-29.2
Rangia cuneata (rangia clam)	9.7	0.15-26.3
Callinectes sapidus (blue crab)	9.4	0.15-29.4
Neritina reclivata (olive nerite)	7.8	7.8

TABLE 84

Average salinity and range at which invertebrate animals were collected in St. Lucie Estuary

Species	Salinity (p.p.t.)	
	Average	Range
Palaemonetes paludosus (grass shrimp)	1.6	0.14-14.8
Macrobrachium acanthurus (river shrimp)	1.3	<1.0-4.9
Palaemon floridana	<1.0	<1.0
Fresh-water snail	<1.0	<1.0
Neritina virginea (Virginia nerite)	<1.0	<1.0
Sesarma cinereum (land crab)	0.8	0.8
Palaemonetes pugio (grass shrimp)	0.19	0.16-0.22

TABLE 85

Number of inverebrate animals with less than five specimens in total collections in St. Lucie Estuary

Four specimens

Cancroid crab

Three specimens

Astropecten articulatus (starfish)
Lolliguncula brevis (squid)

Two specimens

Mogula manhattensis (onion tunicate)
Neritina virginea (Virginia nerite)
Arca sp. (ark shell)
Crepidula plana
Palaemon floridana
Chaetopleura apiculata (chiton)
Polynices duplicata (mooneye)

One specimen

Neritina reclivata (olive nerite)
Pagurus pollicaris (hermit crab)
Paguristes hummi (hermit crab)
Solen viridis (razor clam)
Sicyonia typica (stone shrimp)
Sesarma cinereum (land crab)
Canthurus multangulus
Clathodrillia ostrearum
Ophiothrix örstedii (serpent star)
Calliactis tricolor (sea anemone)
Fresh-water snail

Table 85 lists the numbers of organisms which were caught only a few times.

The invertebrate fauna in the estuary can be divided into several categories. The fresh-water component (*Macrobrachium*, possibly *Palaemonetes*, and the fresh water snail) was quite few in numbers. The same thing can be said of the squid, sea hare, and chiton, which came into the outer estuary only when salinities were quite high. A third

group — such as *Rangia*, *Mulinia*, and the ctenophores — in indigenous. The latter seems to be most abundant at moderately high salinities, and Rangia clams are most abundant at low salinities. A fourth group raises in the estuaries similar to the fishes noted above. This includes three penaeid shrimp and the two swimming crabs. It was noted that the brown shrimp was found in lower salinities than the pink shrimp and in general the blue crab was in lower salinities than the ornate crab. One of those two crabs (blue crab) and the three penaeid shrimp are the only commercial invertebrates. The white shrimp, brown shrimp, and blue crab were common at quite low salinities and are known to raise in such areas (Gunter, 1950). The brown shrimp were most abundant seasonally in May, in both 1957 and 1958. Pink shrimp were found only in October 1958 and January 1959, after the gates were closed. The catch of blue crabs did not vary greatly at any time, and the white shrimp were not abundant at any time. In brief, the opening and closing of the St. Lucie spillway gates might cause a lowering in abundance of the pink shrimp, and possibly the brown shrimp, but it has no effect on the blue crab, the only other indigenous species present in any numbers. Oysters, where they are present, can tolerate a wide range of salinities and sediment conditions, and are most abundant where there is a continuous supply of fresh water drainage. The St. Lucie Estuary has never been an important producer of commercial shellfish.

4. *Species account. Invertebrates.*

The shrimp and larger crabs were counted and measured as taken, but for many of the smaller invertebrates the records were not routinely kept, partly due to their small size and partly because of identification difficulties. Where we are sure of the identifications the records are presented. Studies of fouling organisms were not made.

COELENTERATA

Dactylometra and *Stomolophus*, so commonly reported on the Texas coast (cf. Gunter 1950), were not seen in the St. Lucie Estuary.

Aurellia aurita Lamarck.

The catch records are given in table 86. Exact counts of jellyfish are hard to make after they have been rolled around in the trawl, and they were not attempted in most instances. Similarly, size measurements were not made. The salinities where these jellyfish were caught ranged from 7.8 to 32.4, but all specimens except one were taken at salinities of 15.0 and above. Gunter (1950) took this jellyfish in waters with a salinity range of 18.9 to 30.9 on the Texas coast.

CTENOPHORA

Mnemiopsis mccradyi A. Agassiz.

Ctenophores are, of course, more difficult to handle and count than jellyfish. Comments on abundance of this species are given in table 87. The salinity range where it was caught ranged from 13.8 to 33.8.

TABLE 86
Catch records of *Aurellia aurita*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 16, 1957	TS#2	50	bell 80 mm. & less	26.7	15.2
May 16, 1957	TS#5	few	—	26.7	19.9
May 16, 1957	TS#6	1	—	26.7	22.9
May 16, 1957	TS#7	few	—	25.7	32.4
Oct. 27, 1958	TS#2	few	—	23.9	20.3
Oct. 27, 1958	TS#3	many	—	24.4	15.0
Oct. 28, 1958	TS#5	many	—	23.3	26.3
Oct. 28, 1958	TS#6	2	—	23.3	26.3
Oct. 27, 1958	SS#3	1	—	25.0	7.8
Jan. 27, 1959	TS#2	1	—	20.0	17.1
Jan. 27, 1959	TS#4	2	—	20.0	15.7
Jan. 27, 1959	TS#6	1	—	21.1	24.0

TABLE 87
Catch records of *Mnemiopsis mccradyi*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#1	very abundant		24.1	17.0
May 16, 1957	TS#2	a few		26.7	15.2
May 16, 1957	TS#5	many		26.7	19.9
May 16, 1957	TS#6	several		26.7	22.9
Oct. 28, 1958	TS#5	100-200		22.3	26.3
Oct. 28, 1958	TS#6	several hundred		23.3	26.3
Oct. 27, 1958	TS#7	many		25.6	31.5
Jan. 27, 1959	TS#1	many		18.9	14.7
Jan. 27, 1959	TS#2	many		20.0	17.1
Jan. 27, 1959	TS#3	few		18.9	13.8
Jan. 27, 1959	TS#4	many		18.9	15.7
Jan. 27, 1959	TS#7	many		22.2	33.8

MOLLUSCA

AMPHINEURA

Chaetopleura apiculata Say.

Two of these chitons were taken at TS #7 on 27 January 1959. The water temperature was 22.8 and the salinity was 33.8. The specimens were not measured.

PELECYPODA

Solen viridis Say.

One specimen was taken at TS#6 on 16 May 1957. The water temperature was 26.7 and the salinity was 22.9.

Congeria sp.

Several small specimens were taken at TS#2 and 4 on 27 October 1958. The water temperatures were 23.9 and 25.6 C and the salinities were 20.3 and 20.2.

This species is ordinarily taken in low salinities. Thousands of them are found at times coating the walls of the St. Lucie Locks. Gunter and Shell (1958) found C. *leucophaeta* in Grand Lake, Louisiana growing in tufts on live shells of *Rangia cuneata* where the salinity was never above 2.7 and averaged 0.65.

Mulinia lateralis Say

This species is evidently vastly abundant at times in the St. Lucie. Thousands of dead shells were taken in the lower estuary in the trawls, which is not a good collecting gear for this little mollusk. Table 88 gives the catch records. Dead shells were found at low and high salinities, but live specimens were taken only at salinities from 20.0 to 29.2. Possibly, this mollusk only lives at moderately high salinities and is killed at times by influxes of fresh water into the St. Lucie Estuary. Simmons (1957) found that in the Laguna Madre of Texas, this little clam survived up to salinities of 45 *per mille*.

TABLE 88

Catch records of *Mulinia lateralis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#5	Great many shells (dead)		24.5	20.0
Jan. 28, 1957	TS#6	Numerous live and dead		23.7	29.2
Jan. 29, 1957	SS#2	3	6-12 mm.	24.1	20.0
June 18, 1957	TS#5	Thousands of empty shells		28.8	1.2
Nov. 13, 1957	TS#6	2 dead		22.0	27.2
Oct. 28, 1958	TS#6	124 live		23.3	26.3
Jan. 27, 1959	TS#5	Many empty shells		20.0	22.2

Rangia cuneata Gray.

Many dead shells were found at SS #3 and 4 and TS #3 and 4. No live specimens were taken.

Polymesoda caroliniana Bosc

Catch records are given in table 89. Sixty specimens were taken, mostly at very low salinities. All specimens caught were small, the size range being from 6-18 mm in total length.

Crassostrea virginica (Gmelin).

Oyster shells were taken at TS #1, 4 and 5. Live oysters were not seen.

GASTROPODA

Crepidula plana Say.

One specimen was taken at TS #6 on 18 June 1957 in an empty *Polynices* shell. The temperature was 28.3°C and the salinity was 22.8.

Polynices duplicatus Say.

Nine empty shells were taken at trawl stations 2, 5, 5 and 6. Two live specimens, 31 and 36 mm in shell length were taken at TS #6 on 18 June 1957. The water temperature was 28.3°C and the salinity was 22.8.

Cantharus multangulus Philippi

One specimen was taken at TS #7 on 27 January 1959. It was not measured. The water temperature was 22.2 and the salinity was 33.8.

Clathrodrillia ostrearum

One unmeasured specimen was taken at the same station as the above on the same date.

Nassarius vibex Say

One hundred and twenty-eight of these little snails were counted and we feel that a great many more were brought up by the trawls. It is certainly the most abundant gastropod in the St. Lucie. Table 90 gives the catch records. It was taken only in trawls; all specimens but one were

TABLE 89

Catch records of *Polymesoda caroliniana*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
May 19, 1958	TS#2	5	7-11	25.6	0.15
May 19, 1958	TS#3	2	10-14	25.6	0.27
May 19, 1958	TS#4	50	6-10	25.6	0.24
May 19, 1958	TS#5	1 (many dead shells)	13	25.6	0.15
May 19, 1958	TS#6	1 dead		25.6	0.34
May 19, 1958	TS#7	1	8	24.4-	25.6
Oct. 28, 1958	TS#5	3	13-18	23.3	26.3

TABLE 90

Catch records of *Nassarius vibex*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#6	35	—	23.7	29.2
May 16, 1957	TS#6	33	10-14	26.7	22.9
Sept. 23, 1957	TS#7	1	12	—	23.0
Nov. 13, 1957	TS#4	1	—	22.1	12.7
Nov. 13, 1957	TS#6	15	—	22.0	27.2
Feb. 24, 1958	TS#5	1	12	14.4	< 1.0
Feb. 24, 1958	TS#7	15	—	18.9	29.4
May 20, 1958	TS#6	6	11-13	25.6	0.34
May 20, 1958	TS#7	20	12-16	24.4	25.5
	Grand total	127			

taken in the lower estuary. Apparently, this *Nassarius* likes moderately high salinities, but it was present when fresh water had moved down into its regular habitat. Many small hermit crabs utilize the shell of this little gastropod: they were rarely examined.

Neritina reclivata Say.

Two unmeasured specimens were taken at SS #5 on 25 February 1958. The temperature was 17.2 and the salinity was <1.0. A specimen 15 mm long was taken at SS #3 on 27 October 1958. The temperature was 25.0 and the salinity was 7.8.

TABLE 91

Catch records of *Aplysia willcoxi*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#6	4	25	23.7	29.2
Jan. 29, 1957	TS#7	4	—	22.2	36.0
Jan. 27, 1959	TS#7	3	30-130	22.2	33.8
	Grand total	11			

APLYSIDAE

Aplysia willcoxi Heilprin

Eleven specimens were taken, all at high salinities at the outermost trawl stations. The records are given in table 91. They were all taken in midwinter. Most of the specimens were small.

CEPHALOPODA

Lolliguncula brevis de Blainville.

Two specimens, 20 and 35 mm long, were taken on 28 January 1957 at TS #6. The temperature was 23.7°C and the salinity was 29.2. Another specimen 33 mm long was taken at the same station on 13 November 1957. The temperature was 22.0 and the salinity was 27.2.

This species and the one above illustrate what Günter (1945, 1950) has noted before, that it is often the young of high salinity organisms which enter inshore waters of lower salinity.

CRUSTACEA

Palaemonetes paludosus (Gibbes)

Table 92 gives the catch records. The size range was 17-35 mm in length and the salinities were all low. Females with eyed eggs were taken in February. For some reason this shrimp was taken only at relatively low temperatures, 16.7-20.6°C.

Palaemonetes pugio Holthuis.

Three specimens 25-28 mm long, the smallest with eggs, were taken at SS #4 on 23 September 1957 when the temperature was 28.1 and the salinity was 0.16. Another was taken at TS #4 on 19 May

1958. It was 27 mm long. The temperature was 25.6 and the salinity was 0.22.

TABLE 92
Catch records of *Paleomonetes paludosus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 27, 1958	SS#1A	3	23-34	16.8	1.3
Jan. 27, 1958	SS#3	5	18-31	17.7	0.26
Jan. 27, 1958	SS#4	5	18-28	—	0.25
Jan. 27, 1958	SS#5	3	17-29	17.4	0.35
Feb. 24, 1958	SS#1A	9	17-32 (eyed eggs)	16.7	4.9
Feb. 24, 1958	SS#2	4	15-35	17.2	< 1.0
Feb. 24, 1958	SS#5	5	—	17.2	< 1.0
Jan. 27, 1959	SS#3	7	17-28	20.6	2.4
Jan. 27, 1959	SS#4	1	18	20.0	< 1.0
	Grand total	42			

TABLE 93
Catch records of *Macrobrachium acanthurus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
June 18, 1957	TS#1	2	56-87	28.5	< 1.0
Sept. 23, 1957	TS#1	1	92 (eggs)	28.0	0.16
Sept. 23, 1957	TS#2	3	59-64	28.1	0.18
Sept. 23, 1957	TS#5	4	36-55	23.8	0.17
Nov. 13, 1957	TS#2	1	96 (eggs)	22.1	14.80
May 19, 1958	TS#1	1	78	25.6	0.14
May 19, 1958	TS#2	4 (3 / 1)	60-85 / 94 (eggs)	25.6	0.15
May 19, 1958	TS#4	10 (9 / 1 green eggs)	32-72 / 55	25.6	0.22
May 19, 1958	TS#5	4	34-45	25.6	0.15
May 20, 1958	TS#6	4 (light green eggs)	48-66	25.6	0.34
May 20, 1958	SS#2	1	33	26.1	0.19
	Grand total	35			

Palaemonetes vulgaris (Say).

One shrimp 22 mm long bearing eggs was taken on 28 January 1957 at TS #6. The water temperature was 23.7°C and the salinity was 29.2. Three shrimp 19-37 mm long were taken 16 May 1957. The temperature was 28.3 and the salinity was 3.7.

Palaemon floridana Chace.

Two specimens 24 and 32 mm were taken at SS #5 on 27 January 1959. The water temperature was 20.0°C and the salinity was 1.0. This little shrimp has thin, bright red lines as markings, which fade quickly in preservative. For this reason it is called the peppermint shrimp.

Macrobrachium acanthurus (Weigmann).

Table 93 gives the catch records. The 35 specimens varied from 32-96 mm long. Shrimp bearing eggs were taken in the months of May, September and November. The water temperatures were all relatively high, 22.1-28.5 C. The salinities were all low except that one specimen, the largest with eggs, was taken at a salinity of 14.8. Gunter (1938) has previously noted that another species of this genus, *M. ohione*, enters waters of intermediate salinities when carrying eggs. This habit certainly permits the species to spread from one coastal watershed to another.

Penaeus aztecus Ives

Four hundred and ninety-one brown shrimp were taken. Catch records are given in table 94. The smallest shrimp were taken in January, February, May and October. The fall and summer months were the times of least abundance. Most shrimp were taken at salinities above 20.0, but 146 were taken at salinities below 5.0. Four shrimp were taken at salinities of 0.22 and 0.36. The former is in the fresh water range and is the lowest salinity at which the brown shrimp has been reported. These four shrimp were 28-38 mm long. Gunter (1950) found the smallest brown shrimp on the Texas coast in October, April and May.

Penaeus duorarum Burkenroad

Catch records are given in table 95. Two hundred and twenty-three pink shrimp were taken. Quite small shrimp were taken in October. The lowest salinity at which this shrimp was caught was 13.8.

This shrimp was taken only during two surveys, but was fairly abundant during October 1958. Some early juveniles were taken at that time. The color markings of this shrimp have never been fully described. Actually, the shrimp has a saddle shaped mark extending from the so-called spot on the third abdominal pleon diagonally across the second and over the back end in the spot on the third segment. These markings are relatively clear and are to be found at quite small sizes in freshly caught shrimp. Definitely, marked small pink shrimp are unmistakable when fresh. A pale one may sometimes be mixed with the browns, but the reverse situation does not occur. Museum workers have trouble with these two shrimp at small sizes because the colors fade.

Penaeus fluviatilis Say.

Only 17 specimens of the white shrimp were caught (table 96). This shrimp is approaching the end of its disjunct range on the southeast Florida coast, and apparently it is not abundant in the St. Lucie area or more would have been taken at low salinities, as is the case in other parts of its range. White shrimp probably raise in the St. Lucie in small numbers for one juvenille, 50 mm in length, was taken in June. It has not been reported south of the St. Lucie on the east Florida coast.

Sicyonia typica (Boeck)

One specimen, 20 mm long, was taken at TS #6 on 28 January 1957. The temperature was 23.7° and the salinity was 29.2.

Callinectes ornatus Ordway.

Catch records are given in table 97. The salinity range was 0.34 to 36.0. One hundred and thirty-two specimens were caught. Only five small specimens were taken at salinities below 5.0. The smallest specimens were taken in January 1957 and January 1959. Females ranging in carapace width from 73-120 mm were taken in October 1958 and

TABLE 94
Catch records of *Penaeus aztecus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#1	41	31-91	24.1	17.0
Jan. 28, 1957	TS#2	9	7 (20-38) 2 (74-78)	23.3	20.5
Jan. 28, 1957	TS#4	2	54-55	23.8	20.0
Jan. 28, 1957	TS#5	12	28-71 (aver. 47.6)	24.5	21.0
Jan. 28, 1957	TS#6	3	37-71	23.7	29.2
Jan. 29, 1957	SS#2	2	47	24.1	20.0
Jan. 29, 1957	SS#4	4	20-46	24.3	17.0
May 16, 1957	TS#1	118	35-77 (aver. 60)	26.0	10.0
May 16, 1957	TS#2	20	36-78	26.7	15.2
May 16, 1957	TS#4	52	19-70	26.5	12.7
May 16, 1957	TS#5	11	37-76 (aver. 53)	26.7	19.9
May 16, 1957	TS#6	11	47-82	26.7	22.9
May 16, 1957	SS#4	1	40	28.0	9.5
June 18, 1957	TS#2	49	34-87	28.7	0.7
June 18, 1957	TS#4	17	25-60	29.3	< 1.0
June 18, 1957	TS#6	3	36-85	28.3	22.2
Sept. 23, 1957	TS#6	2	48-51	23.4	2.34
Sept. 23, 1957	TS#7	1	43	—	23.5
Sept. 23, 1957	SS#1A	1	45	31.1	7.5
Nov. 13, 1957	TS#2	2	45-57	22.1	14.8
Nov. 13, 1957	TS#3	1	30	22.1	10.1
Nov. 13, 1957	TS#6	3	39-53	22.0	27.2
Jan. 28, 1958	TS#6	2	28-37	15.0	0.36
Jan. 27, 1958	TS#7	1	40	16.5	4.5
Jan. 27, 1958	SS#1A	1	34	16.8	1.3
Feb. 24, 1958	SS#1A	1	20	16.7	4.9
May 19, 1958	TS#4	2	34-38	25.6	0.22
May 20, 1958	TS#6	51	20-53	25.6	0.34
May 20, 1958	TS#7	35	22-88	24.4	25.5
May 20, 1958	SS#1A	20	18-54	25.6	1.04
Oct. 27, 1958	TS#1	1	39	23.9	7.8
Oct. 27, 1958	TS#2	3	56-64	23.9	20.3
Oct. 27, 1958	TS#4	2	49-59	25.6	20.2
Oct. 28, 1958	TS#6	5	50-78	23.3	26.3
Oct. 27, 1958	SS#1A	2	20-67	25.6	27.4
	Grand total	490			

January 1959. The time of appearance of smaller specimens and of eggs shows that this crab is a fall and winter spawner in south Florida

Callinectes sapidus Rathbun.

Catch records are given in table 98. One hundred and ninety-four specimens were caught. Smaller crabs, 15 mm in carapace length and

less, were taken in the months of September, November, January, February and May.

Females bearing eggs were taken in January and May 1957 and in May 1958. The salinity and temperature ranges where egg-bearers were caught were 20.0-29.2 *per mille* and 23.7-26.7°C. January is not the ordinary spawning month for the blue crab over most of its range and we thought this was a phenomenon peculiar to south Florida, until it was realized that unpublished data show that crabs off the northern Gulf coast (Mississippi) also carried eggs in January 1957, a heretofore unheard of thing. An examination of the table will show that the January 1957 temperatures were considerably higher than in January 1958 and 1959 when no crabs in berry were taken.

It is well known that this crab is euryhaline (Cf. Gunter, 1938). The salinity range at which it was caught was 0.14 to 29.2 *per mille*. Forty-eight crabs ranging in carapace length from 12 to 128 mm were taken in the fresh water range (see table 98).

Sesarma cinereum Say.

One female, 25 mm wide, with reddish orange eggs was taken at SS' #2 on 16 May 1957. The water temperature was 30.0 and the salinity was 0.8.

TABLE 95

Catch records of *Penaeus duorarum*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Oct. 27, 1958	TS#2	149	24-77	23.9	20.3
Oct. 27, 1958	TS#3	8	22-49	24.4	15.0
Oct. 27, 1958	TS#4	21	17-63	25.6	20.2
Oct. 28, 1958	TS#5	27	32-69	23.3	26.2
Oct. 28, 1958	TS#6	1	41	23.3	26.3
Oct. 27, 1958	SS#1A	3	13-32	25.6	27.4
Jan. 27, 1959	TS#1	2	38-47	18.9	14.7
Jan. 27, 1959	TS#2	5	42-74	20.0	17.1
Jan. 27, 1959	TS#3	2	48-59	18.9	13.8
Jan. 27, 1959	TS#4	4	56-68	18.9	15.7
Jan. 27, 1959	TS#5	1	65	20.0	22.2
	Grand total	223			

TABLE 96

Catch records of *Penaeus fluviatilis*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#1	1	105	24.1	17.0
Jan. 28, 1957	TS#5	1	104	24.5	21.0
May 16, 1957	TS#2	1	145	26.7	15.2
June 18, 1957	TS#2	12	50-125	28-7	0.7
Oct. 27, 1958	TS#2	2	103-104	23.9	20.3
	Grand total	17			

TABLE 97
Catch records of *Callinectes ornatus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 29, 1957	TS#7	3	15-20	22.2	36.0
Jan. 29, 1957	SS#2	33	12-33	24.1	20.0
Jan. 29, 1957	SS#5	2	24-39	24.0	19.3
May 16, 1957	TS#1	25	33-52	26.0	10.0
May 16, 1957	TS#2	1	48	26.7	15.2
May 16, 1957	TS#3	2	27-31	26.5	5.4
May 16, 1957	TS#5	3	16-37	26.7	19.9
May 16, 1957	TS#6	8 (7	44-77	26.7	22.9
		(1	72		
May 16, 1957	TS#7	1	82	25.7	32.4
June 18, 1957	TS#4	1	16	29.3	< 1.0
June 18, 1957	TS#5	1	20	28.8	1.2
June 18, 1957	TS#6	2	30-36	28.3	22.2
June 18, 1957	SS#6	1	29	—	2.7
May 20, 1958	TS#6	2	15-19	25.6	0.34
May 20, 1958	TS#7	2	25-51	24.4	25.5
Oct. 28, 1958	TS#5	1	27	23.3	26.3
Oct. 28, 1958	TS#6	1	37	23.3	26.3
Oct. 27, 1958	TS#7	4 (2	85-120 (brown eggs)	25.6	31.5
		(2	19-85		
Oct. 27, 1958	SS#1A	6	17-43	25.6	27.4
			(eggs above 73 mm.)		
Jan. 27, 1959	TS#6	15 (11	59-85	21.1	24.0
		(4	55-100		
Jan. 27, 1959	TS#7	1	35	22.2	33.8
Jan. 27, 1959	SS#1A	9	12-40	21.1	25.9
Jan. 27, 1959	SS#2	8	11-15	22.8	6.3
	Grand total	132			

Paguristes hummi Wass.

Hermit crabs were not examined closely, because they were often small and hid in their shells too long. We saw several specimens of *P. hummi*, which heretofore has only been reported from the northwest part of the Florida peninsula: however, we have only one definite record. One specimen was taken at TS #7 on 29 January 1957. It was in a shell 13 mm long. The water temperature was 22.2 and the salinity was 36.0.

Pagurus pollicaris (Say).

One specimen in a *Polinices* shell 40 mm long was taken at the same station as the above. The shell bore one *Adamsia tricolor*, a common associate of this crab, and several *Crepidula plana*.

Clibanarius vitattus (Bosc).

Catch records are given in table 99. Twenty-six live and one dead specimen were taken in shells, mostly *Polinices*, ranging from 26-38 mm long. The temperature ranged from 16.5-31.1°C and the salinity range was from 2.3-36.0.

TABLE 98

Catch records of *Callinectes sapidus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28 1957	TS#1	3 (2	87-180		
		(	75	24.1	17.0
Jan. 28, 1957	TS#2	1	18	23.3	20.5
Jan. 28, 1957	TS#4	1	195	23.8	20.0
Jan. 28, 1957	TS#5	2	160-162	24.5	20.0
			(brown eggs)		
Jan. 28, 1957	TS#6	5 (2	22-127 (dk. yellow eggs)		
		(3	83-99	23.7	29.2
Jan. 28, 1957	SS#4	1	37	24.3	17.0
		(2	85-145		
May 16, 1957	TS#1	9 (7	83-135	26.0	10.0
May 16, 1957	TS#2	1	156	26.7	15.2
May 16, 1957	TS#4	3	14-17	26.5	12.7
May 16, 1957	TS#6	2	165-195	26.7	22.9
			Yellowish-dk. brown sponge		
May 16, 1957	SS#3	1	21	28.3	3.7
June 18, 1957	TS#4	1	152	29.3	< 1.0
June 18, 1957	TS#6	17	120-173	28.3	22.8
			(av. 145)		
Sept. 23, 1957	TS#2	1	106	28.1	0.17
Sept. 23, 1957	TS#3	1	18	23.1	0.17
Sept. 23, 1957	TS#4	2	12-150	22.9	0.18
Sept. 23, 1957	TS#5	1	19	23.4	0.34
Sept. 23, 1957	SS#4	2	15-36	28.1	0.16
Nov. 13, 1957	TS#1	1	38	21.9	11.5
Nov. 13, 1957	TS#2	2	26-194	22.1	14.8
Nov. 13, 1957	TS#3	3	15-40	22.1	10.1
Nov. 13, 1957	TS#4	1	19	22.1	12.7
Nov. 13, 1957	TS#5	1	not measured	21.8	16.2
Jan. 27, 1958	TS#1	1	98	15.5	0.18
Jan. 27, 1958	TS#2	1	46	15.8	0.23
Jan. 27, 1958	TS#4	1	122	16.8	0.26
		(2	98-120		
Jan. 28, 1958	TS#6	3 (1	125	15.0	0.36
Jan. 27, 1958	TS#7	6 (5	126-195	16.5	4.5
		(1	120		
Jan. 27, 1958	SS#4	4 (3	57-78	—	0.25
		(1	61		
Jan. 27, 1958	SS#5	4 (2	18-23	17.4	0.35
		(2	17-30		
Feb. 24, 1958	TS#4	1	142	14.4	< 1.0
Feb. 24, 1958	TS#5	1	115	14.4	< 1.0
Feb. 24, 1958	TS#6	3 (2	68 85	16.1	7.0
		(1	170		
Feb. 24, 1958	TS#7	9	80-175	18.9	29.4
Feb. 24, 1958	SS#1A	10	8-20	16.7	4.9
Feb. 24, 1958	SS#2	3 (2	22-35	17.2	< 1.0
		(1	36		

TABLE 98

Catch records of *Callinectes sapidus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Feb. 24, 1958	SS#3	1	12	16.7	< 1.0
Feb. 24, 1958	SS#4	1	42	14.4	< 1.0
Feb. 24, 1958	SS#5	1	58	17.2	< 1.0
Feb. 24, 1958	SS#6	1	35	17.8	< 1.0
May 19, 1958	TS#2	8 (5	85-108	25.6	0.15
		(3	96-138		
May 19, 1958	TS#3	1	40	25.6	0.27
May 19, 1958	TS#4	4 (3	38-145	25.6	0.24
		(1	125	25.6	0.24
May 19, 1958	TS#5	1	178	25.6	0.15
May 20, 1958	TS#6	4	15-60	25.6	0.34
May 20, 1958	TS#7	2 (yellow eggs)	140-164	24.4	25.5
May 19, 1958	SS#2	3	17-58	26.1	0.19
May 19, 1958	SS#3	3	28-94 (soft)	25.6	0.28
May 19, 1958	SS#4	4 (3	28-75	26.1	0.14
		(1	45		
Oct. 27, 1958	TS#1	6 (2	22-33	23.9	7.8
		(4	40-155	23.9	
Oct. 27, 1958	TS#2	10 (8	21-152	23.9	20.3
		(1	97		
		(1	16		
Oct. 27, 1958	TS#3	1	150	24.4	15.0
Oct. 27, 1958	TS#4	1	170	25.6	20.2
Oct. 27, 1958	TS#5	1	38	23.3	26.3
Oct. 28, 1958	TS#6	1	32	23.3	26.3
Oct. 27, 1958	SS#3	1	24	25.0	7.8
Oct. 27, 1958	SS#2	1	33	25.6	14.0
Jan. 27, 1959	TS#1	8 (2	85-148	18.9	14.7
		(6	45-200		
Jan. 27, 1959	TS#2	4 (2	60-85	20.0	17.1
		(2	145-175	20.0	
Jan. 27, 1959	TS#3	3 (1	160	18.9	13.8
		(2	77-177		
Jan. 27, 1959	TS#4	2 (1	53	18.9	15.7
		(1	47		
Jan. 27, 1959	TS#6	6 (4	150-160	21.1	24.0
		(2	102-137		
Jan. 27, 1959	SS#1	1	145	21.1	25.9
Jan. 27, 1959	SS#2	2	35-35	22.8	6.3
Jan. 27, 1959	SS#4	1	14	20.0	< 1.0
Jan. 27, 1959	SS#5	1	13	20.0	< 1.0
Jan. 27, 1959	SS#6	1	20		10.4
	Grand total	194			

ECHINODERMATA

Astropecten articulatus (Say).

Three specimens. 110 to 160 mm across were taken at TS #7 on

27 January 1959. The largest specimen was carrying eggs. The water temperature was 22.2 and the salinity was 33.8.

Ophiothrix orstedii Lutken.

One specimen, 85 mm across, with eggs, was taken at the same station as the above.

TABLE 99

Catch records of *Clibanarius vitattus*

Date	Station	No. of Specimens	Total length in millimeters	Temp. °C	Salinity o/oo
Jan. 28, 1957	TS#2	1 (Polinices shell)		23.3	20.5
Jan. 28, 1957	TS#3	1 (Polinices shell)	26 (barnacles)	23.3	14.8
Jan. 29, 1957	TS#7	6 (Polinices shell)	10-30	22.2	36.0
June 18, 1957	TS#6	3 (Polinices shell)	24-30	28.3	22.8
Sept. 23, 1957	TS#6	3 (Polinices shell)	35-38	23.4	2.3
Sept. 23, 1957	SS#1A	1 (Polinices shell)	32	31.1	7.5
Nov. 13, 1957	TS#6	1 dead		22.0	27.2
Jan. 27, 1958	TS#7	1 (Polinices)		16.5	4.5
Feb. 24, 1958	TS#7	1 (Polinices)	35	18.9	29.4
Jan. 27, 1959	SS#6	9 all in Polinices, taken from tree roots on shore		22.2	10.4
	Grand total	27			

CHORDATA

Molgula manhattensis DeKay.

One small unmeasured specimen was taken at TS #1, 16 May 1957, when the temperature was 26.0 and the salinity was 10. Another, 8 mm in diameter when contracted, was taken at TS #4 27 October 1958. The temperature was 25.6 and the salinity was 20.2.

5. *Cold kill of fishes, January-February* 1958 — As was shown with the temperature data given earlier in this report, the winter of 1957-58 was one of the coldest of record for central and southern Florida. In connection with the several periods of freezing temperature that occurred in January and February, fish kills of considerable proportions also occurred throughout this State and other coastal sections of the southeast United States. During the February 24-26, 1958, sample, large numbers of dead fish were observed floating in the estuary and lying along the shorelines (Figure 3). These were predominantly ladyfish or ten-pounder (*Elops saurus*) and sand perch (*Diapterus olisthostomus*), with some snook, tarpon, and mullet. Many specimens which had been dead for some time were dragged up with the trawl. The great majority of the dead fish were adults, with some of the tarpon measuring up to 5 feet. There was considerable evidence that the cold weather was the cause of the kill, as follows:

a. The kill occurred in all parts of the estuary, including far up the North Fork, which area was unaffected by discharge from St. Lucie Canal.

b. Fish kills were reported about the same time for other parts of Florida (Tampa Bay and Biscayne Bay) and for coastal areas in Georgia and South Carolina and to the west in Mississippi and Texas. The

Jacksonville District made inquiries of State and Federal fish and wildlife agencies and university laboratories to verify such reports.

c. Just prior to the observed kills in St. Lucie Estuary, the Stuart News reported the lowest weekly average temperature of record.

d. The fact that primarily large fish were killed is a known phenomenon associated with temperature kills of fishes (Brongersma-Sanders, 1957; Gunter, 1947).

e. The fishes killed in St. Lucie Estuary were principally those with tropical distribution. Such species are more susceptible to decreasing temperature changes and generally leave the colder inner waters during the winter for the deeper, warmer waters of the ocean. However, quick drops in temperature will trap many of them in the inner bays before they are able to leave.

f. The largest number of fish taken in any of the 10 samples over the 2-year period were collected in the February 1958 sample. If the fish kill had resulted from anything but the cold temperatures, such as freshwater discharge or pollution, it would have been more widespread and less selective of adult, tropical species.

g. Data from the cold kill also furnished evidence that the freshwater discharge does not drive out or destroy all the large game fishes. If it had done so during the previous month of continuous high discharge, then there would have been no large tarpon, snook, and ladyfish remaining in the estuary to be killed by the cold. In addition to the many small live fish that were taken, edible size croaker and drum, which are more tolerant of cold waters, were abundant in the outer estuary (Figure 4).

G. SUMMARY AND CONCLUSIONS

The St. Lucie Canal is one of the two available outlets from Lake Okeechobee, whose level must be controlled for irrigation and hurricane-tide control. The other outlet discharges to the Gulf of Mexico through Caloosahatchee River. The St. Lucie Canal was originally constructed by the Everglades Drainage District between 1916 and 1924. It was taken over by the Corps of Engineers in 1930, following serious hurricane damage and the loss of many lives on the shores of Lake Okeechobee. The canal leaves Lake Okeechobee at Port Mayaca and extends northeast 25.6 miles to the south fork of St. Lucie River. St. Lucie Lock and Dam are located 1.9 miles west of the easterly end of the canal and about 23.7 miles from Lake Okeechobee. St. Lucie Canal is part of the main channel of east and west boat traffic between the Gulf of Mexico and the Atlantic Ocean. Navigable depth is 8 feet.

St. Lucie Estuary consists of a North Fork and South Fork and a main estuary roughly in the shape of a Y. It empties into a coastal lagoon — Indian River — near the entrance to the Atlantic Ocean. The surface area is 5,530 acres; the water volume is 41,150 acre-feet; and length of the shoreline is 35.5 miles.

Discharge through St. Lucie Lock and Dam into the South Fork of the estuary has a peak rate of about 9,000 cubic feet a second when the Lake Okeechobee level is near 18.0 feet. Peak flood drainage into the North Fork through creeks, drainage ditches, and small canals is at about the same rate.

Discharges through St. Lucie Canal between 1945 and 1958 ranged

from zero in 1950 and 1956 to 2,687,000 acre-feet in 1947. The years 1947, 1948, 1953, 1954, and 1958 were those of high discharges. In other years, the discharge was moderate, low, or zero. The average annual discharge during that period was 1,062,000 acre-feet. The heaviest discharge has been from August to December in most years, with lesser peaks from January to April in a few years.

The present investigation was begun in January 1957 and was terminated in January 1959. The chief aim was to sample the population of fishes in all three branches of St. Lucie Estuary as well as it could be done by trawls and by small seines on shore. This method does not sample the larger fishes very well, but it is generally good for the small fishes and invertebrates. This matter is of particular importance because of local contentions that the small fishes were killed by the fresh water and because bays and estuaries are primarily nursery grounds (cf. Gunter 1945, page 119). Seven trawl stations and six seine stations were set up at localities described in the text. Bottom and surface temperatures and salinities were determined at each trawl station, and one salinity and one temperature were taken at the shallow shore stations. Each station was visited roughly every 3 months and a complete round of all stations was made 10 times during the 2-year period. Thus, the data give some information on seasonal changes.

Five of these biological surveys of the area were made during times of no discharge; five were made during periods of discharge; and three were made during very heavy discharges. One of the surveys was made following one of the most extreme cold spells the region has experienced since the Weather Bureau records were started in south Florida.

In the course of this study, 68 trawl hauls and 103 seine hauls were made. All animals caught were identified and measured, except in certain instances when there were hundreds of small fishes with a size range of only a few millimeters. In such cases, only the maximum and minimum sizes were determined. Organisms which could not be identified in the field were preserved and studied more carefully at the Gulf Coast Research Laboratory. Secchi disk determinations of turbidity were made at each station. Air temperatures were also taken at each station and they were supplemented by the study of maximum and minimum daily air temperatures at Stuart.

Eighty-three species of fishes and 24,783 specimens were taken. Sixty-four of those species were marine, and the total number of marine specimens was 24,151. Nineteen species of fresh-water fishes and 632 specimens were taken. Although the salinity of the water at various stations was often very low, and in or near the fresh-water range, the predominance of marine fishes was overwhelming. The 13 species which were taken more than 100 times each made up 95.2 percent of the total catch and the remaining 70 species made up only 4.8 percent of the catch. The white catfish and the black crappie were the only fresh-water fishes taken more than 100 times.

Five species — the striped mullet, menhaden, croaker, salt-water silverside, and the bay anchovy — were taken more than 1,000 times each. They made up 89 percent of the catch. Those fishes are all forage fishes and they are extremely important to the biological economy of the area. Small mullet alone made up almost 50 percent of the catch. Those fishes regularly grow up in estuarine areas at low salinities, and their condition is evidently enhanced by the release of fresh water into the estuary. This is shown by the fact that the greatest number of specimens

was taken in January and February 1958 when the releases through the lock were at 7,380 and 4,000 cubic feet a second respectively. During these two surveys, 14,016 fishes were taken — considerably more than half of the total.

The greatest numbers of species taken during any one survey (40) were taken in January 1958. At that time, there was no particular diminution in the number of marine species, but an increased number of fresh-water fishes was taken. During November 1957, only 269 fishes were taken. During October 1958, only 562 were taken. The locks were closed at those times. In January 1959, when the locks were closed, 1,408 fish were taken — a decrease of more than 78 percent from the previous year when the locks were open. This figure is due largely to the diminution of the numbers of the five forage fishes mentioned above.

Many large snook were taken in the trawls when the water was extremely turbid. Sand perch, croakers, spot and white trout were also taken in the trawls and they did not leave the area when the salinities were low. The pompano and the small snappers were absent from the low salinity water.

Fishes which live in estuaries are capable of standing quite large variations in salinity, especially towards the lower side, and the general population of fishes in St. Lucie Estuary is very similar to that of other areas. Their condition seems to be generally enhanced by moderately low salinities and they are not produced in great numbers when the salinity is high, as in a salt-water lagoon. Thus, their numbers increased when there was a flow of water through St. Lucie Lock.

The greatest numbers of mullet, menhaden and croakers, silversides, and anchovies were taken when the salinity of the water was less than 0.5 o/oo. In fact, the numbers of those species taken at that salinity — which is drinkable water — was almost three-fourths of the total catch of the investigation.

Thirty-six species of invertebrates were caught and there were several differences betwen the invertebrate and the fish catch. Less than 2,000 specimens were taken, if the comb jelly *Mnemiopsis* is discounted. This little jellyfish was extremely abundant at salinities above 13.8 o/oo and often the trawl catch was a mass of jelly, quite indistinguishable so far as numbers are concerned. Aside from that animal, seven species were taken more than 100 times. These, in order of abundance, were the brown shrimp, the pink shrimp, the cloverleaf jellyfish, the blue crab, a small clam, *Mulinia*, the ornate crab, and *Nassarius*, a marine snail. One hundred and fourteen specimens of that snail were taken. Four hundred and ninety-one brown shrimp and 224 pink shrimp were taken. There were 186 blue crabs. White shrimp were also found in the estuary, but they are not abundant and only 17 were taken. One species of grass shrimp, a river shrimp — *Macrobrachium*, and one specimen of fresh-water snail were the only fresh-water species taken. They numbered less than 75 specimens. Thus, the salt-water contingent of the invertebrates greatly outnumbered the fresh-water specimens, similar to the case with the fishes. Most of those animals were small. The blue crab, the brown shrimp, and the pink shrimp are the only animals of commercial importance. The first two were taken at times below 0.22 o/oo salt. This is fresh water and below the salinity of hard fresh water. It is a well known fact that these two species raise in estuarine water of low salinity, as off the Louisiana coast, and it is obvious that the in-

flux of fresh water does them no damage. The salinity ranges at which the most important invertebrates were taken are given in table 84.

Salinity maps of the area (plates 8 through 17) show that there is a wedge of salt water in the lower part of the main estuary above about 25.0 o/oo at all times except during the very highest discharges from St. Lucie Lock and Dam — such as occurred in January and February 1958. This means that even the most saliniphilous species of fishes can find a refuge to their liking in the lower estuary during all but the most extreme discharges. It would suggest that they might even be concentrated there.

The cold kill of many large fishes — tenpounders, sand perch, tarpon, and others — noted in the estuary in February 1958 followed the lowest recorded average weekly air temperature at Stuart. These fishes are predominantly of tropical distribution. Numbers of croakers, spot, pigfish, and gobies — fishes of temperate distribution — were taken alive in the trawls at the same time.

The outflow of water through St. Lucie Lock and Dam does not damage commercial fishing. It causes turbid conditions which clear up quickly when the flows are stopped. A few high-salinity species are pushed into the lower estuary and — at times of the heaviest discharge — into Indian River or the ocean. No fishes are killed by fresh water and, to the contrary, the reproduction of common estuarine forms is enhanced. These produce forage fishes which serve as food for other larger fishes, and the total production and fertility of the area are increased by outflows of fresh water. Fishing from the St. Lucie Lock and Dam area and possibly from the bridge in the main estuary is benefited by low to moderate fresh-water outflow and this compensates in part, if not altogether, for the migration of certain saliniphilous species. A great many of the common sports fishes do not leave the area even when the salinities are quite low. This study produced no evidence as to whether they bite less during such periods.

St. Lucie Estuary is characterized as an area of high production of a wide variety of sport and food fishes, a condition which has developed and been enhanced by periodic discharges of fresh water and nutrient materials. From the overall and long-range viewpoint, moderate flows of fresh water through St. Lucie Lock and Dam (2,500 to 3,500 c.f.s., or thereabout), especially during certain periods of the year, would continue to benefit the fisheries of St. Lucie Estuary.

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